J. Hunter

1949

RESEARCH REPORT

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Foreword

The annual Research Report is prepared in advance of the Annual meeting by the members of the Research Committee as a supplement to the Conference Proceedings. The report consists of abstracts submitted by research Cooperators who undertook various investigations in the season preceding the Conference. In some projects data from work started in 1948, which could not be properly evaluated before the 1949 season, are included.

The preparation of this report is handicapped by the very limited time available between the completion of harvests in many areas of the conference region. In spite of this difficulty the Committee has felt that advance preparation is desirable in order to have a reasonable basis for formulating a policy statement to be presented to the N.C.W.C.C.

In January, 1949, the Research Committee revised the Coordinated Project outlines and broadened the base of most projects in order to include more crops and the large number of newer herbicides which have been made available for investigation in weed control work. Provision was made for any degree of participation by individual cooperators.

Projects I and II were continued, about as they were outlined in previous years, to facilitate the accumulation of data concerning the response of annual and perennial weeds to 2,4-D at various stages of growth and at various rates of application. These data are of considerable importance to all who are interested in any phase of weed control with 2,4-D and related compounds.

Expansions and other changes in the older projects were explained in the plan of Coordinated projects for 1949 and are, for the most part, self explanatory in this Research Report.

The data reported for sugar beets are from the results of a separate coordinated set of experimental plans distributed to those research workers who are especially interested in this problem. The group consists of State Experiment Station, Beet Sugar processors and Bureau of Plant Industry personnel.

In this Sixth Annual Research Report a regional summary for each Project has been prepared by the Project Leaders. The abstracts submitted by research cooperators are arranged alphabetically, by authors, directly after the summary. Individual abstracts are not numbered but all authors have been indexed and the various pages where their contributions may be found are indicated in the index. This, in addition to the Table of Contents, should make possible a ready access to the available information on any phase of the work accomplished in 1949.

Tabular data from individual cooperators have been assembled as a separate unit and made available to contributors only. They are not considered as a part of this published report.

Your Committee wishes to express appreciation for the fine spirit of cooperation which exists among the contributors to this report. Without this cooperation it would not be possible to prepare such a report and it is our sincere conviction that progress in weed research is made much more rapidly because of a willingness to share responsibilities and accomplishments.

As Chairman of the Committee, I wish to thank all who have contributed to the work in 1949 and to express particular appreciation for the efforts of the various Project Leaders. The real burden in getting projects outlined and data organized has been on their shoulders.

I would also like to express the hope that spirit which has always been evident in the N.C.W.C.C. may continue and that results in weed control practices will be proportional to that spirit.

B. H. Grigsby

Chairman, Research Committee

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Project I. Use of Herbicides in Control of Perennial Herbaceous Weeds.

Canada thistle

Investigation leader: A. L. Bakke

Summary

It is a difficult matter to exterminate Canada thistle with 2,4-D, one treatment, no matter what the concentration, has not given favorable results. 2,4-5-T has proven to be no more effective than the ester formulation of equal concentration. With an ester formulation the economical concentration has been 1/2 to one pound equivalent per acre. The most effective time for treatment has been the early bud stage but earlier treatments particularly where thistles in small grain have kept the weed from competing with the associated crop. Treatments made when the thistle is in the early bloom stage have prevented further development. Seed setting has not taken place. Fall treatments unless followed by two treatments the following year can not be recommended. Canada thistle growing in corn may be sprayed by high clearance machines, but there should be two applications during the season with provision for treatments the following year. It appears as if thistles in meadows where timothy, brome or blue grass are present may be more effectively controlled with 2,4-D than where they are present in other crop lands. A combination of 2,4-D and certain cultural practices may have considerable merit. Good results have been reported where thistles were sprayed with 2,4-D and later the infested ground was seeded to small grain or smother crops. Sodium chlorate still remains the best herbicide for the elemination of Canada thistle. Ammate has not proven to be as effective.

Abstracts of Results of Cooperators

Response of entire-leaved Canada thistle (Cirsium-arvense var. integrifolium) to herbicides. Coupland, R. T. Unreplicated plots of entire-leaved Canada thistle 10 by 7 feet in size were treated on silty clay loam in the dark-brown soil zone at Saskatoon during the dry summer of 1948 with ethyl ester of 2,4-D and with 50 and 75 per cent mixtures of this and 2,4,5-T at 1, 1.5 and 3 pounds of acid per acre in 5 gallons of water. Solid infestations of the weed, averaging 64 shoots per square yard, were treated while in flower on June 29. The temperature was 78° F., the sky was clear and an 18 m.p.h. wind was blowing. Recounts made one month after treatment showed variations from 35 per cent increase to 28 per cent decrease in stand and averaged the same as at treatment. Two months after treatment the range was from no reduction to 75 percent reduction with an average of 43 per cent reduction in stand. No constant advantage was noted of the 2,4-D over the mixtures or of the 3-pound over the 1-pound rates. The same plots were retreated in late September, 1948, when the weed was in the vegetative stage, with the same chemicals at the same rates. This treatment was ineffective, as shown by the vigorous stands produced on treated areas during 1949 which were as healthy and dense as the controls. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

The effect of 2,4-D on perrenial weeds in spring sown wheat. Friesen, H. A. The amine and ester formulations of 2,4-D were applied at four rates, viz: 4, 6, 8 and 12 ounces acid per acre to perennial sow thistle Sonchus arvensis, Canada thistle Cirsium arvense and toadflax Linaria vulgaris. The treatments were made at three stages of weed growth, viz: 1) when 2 - 4 inches tall, 2) when 6 - 8 inches tall and 3) when in early bud (toadflax was not treated at this stage).

Complete top growth kills of Canada and perennial sow thistle resulted at the first two treatment dates where the 6, 8 and 12 ounce rates of ester and the 8 and 12 ounce rates of amine were used. Regrowth and new growth was light and slow, only a few scattered plants advanced to the flowering stage. Regrowth was not abundant until late August. The effect of these treatments was to materially reduce the competition of these weeds and permit near weed free conditions for crop growth. The lower rates were effective only in retarding the thistle development for some two weeks. The 8 and 12 ounce rates of ester and 12 ounce rate of amine resulted in fair top growth kills of Canada and sow thistle in the early bud stage and prevented flowering. This stage, however, was rather late to appreciably limit their competition with the crop, this was particularly true where the patches were heavy.

Unsatisfactory top growth control of toadflax resulted from each of the above treatments. The poor kills could possibly be due to the extremely dry weather conditions in the early spring at Marsden, Sask., where the tests were conducted. (Contributed by the Dominion Experimental Station, Scott, Sask.)

The effect of herbicides on perennial weeds on land not in crop. Friesen, H. A. Canada thistle, Cirsium arvense and perennial sow thistle, Sonchas arvensis were treated with the ester and amine formulations of 2,4-D at five rates viz: 1/2, 3/4, 1, 2 and 3 pounds acid per acre in 1949. The treatments were made at four stages of weed growth, viz: 1) spring rosette, 2) first bud, 3) full bloom and 4) fall rosette. At the first two treatment dates, complete top growth kills resulted from all rates except the amine at 1/2 pound per acre. The 1, 2 and 3 pound rates of ester and amine applied at the flowering stage resulted in complete top kills while the 1/2 and 3/4 pound rates resulted in severe twisting and near complete killing. Fall treatments appeared to be ineffective.

Root kills in 1949 were not complete as a result of any of the treatments made. By October 1, 1949, regrowth on plots treated in the early bud stage was some 30 percent less than that on plots treated at the spring rosette and flowering stages.

On similar treatments made in 1948 regrowth in 1949 was approximately 15 percent of the original stand where the three heaviest dosages of ester were used in the first bud stage and 35 percent where the two lighter rates were used. The amine treated plots had nearly 10 percent more regrowth on correspondingly treated plots.

In mid August of 1948 a portion of each plot was plowed and kept black until freeze-up. Regrowth on nay of the plowed portions did not exceed 10 percent in 1949. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Effect of two 2,4-dichlorophenoxyacetic acid formulations on Canada thistle (Cirsium arverse) in crop (Olli Barley) sprayed at two different growth stages using 3 different rates. Leggett, H. W. The formulations used were triethanolamine and butyl ester formulations. Due to unseasonable weather conditions the stages were as follows: (1) Rosette to pre-bud in almost equal numbers (2) Full bloom. The rates used were 4, 8 and 12 ounces of acid per acre on triplicate plots 10 feet wide by 10 rods in length. 5 (square yard) weed counts were taken from each plot and tabulated as follows: (1) Complete topgrowth kill. (2) Topgrowth control (stunted and producing no seed). (3) Unaffected. The percent topgrowth completely killed was comparatively low in all stages, rates and formulations with one exception, that of 12 ounces butyl ester in stage 1 which gave a complete topgrowth kill of 99.2 percent. There was a difference between stages, stage 1 showing a larger percentage topgrowth kill than stage 2 and with an increase in rate the trend is

upward; also the butyl ester shows to better advantage than the amine in this respect. Combining the percentages of topgrowth kill and control gave excellent results, these ranging from 92.3% to 100% for all rates, formulations and stages with only a slight upward trend as the rate increased up to the 12 ounces of acid. No significance can be found between formulations, only a trend in favor of the butyl ester over the triethanolamine. Between stages the amine showed to better advantage in stage 1 over the amine in stage 2 and the ester in stage 2 over the ester in stage 1. The amine formulations showed a greater percentage of unaffected plants than the ester in the overall picture. Sprayings at both stages were done when growing conditions were ideal and none of the grain in any of the plots was affected. (Contribution of the Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada.)

Large scale control of Canada thistle (Cirsium arvense) with ethyl ester of 2,4-D. Pavlychenko, Thomas K. Since 1945 extensive tests under wide range of ecological conditions and soil types were carried out in Saskatchewan with different formulations of 2,4-D at various rates and stages of growth. It was observed that: (1) Esther usually gave better results than either amine or sodium salts. (2) Treatments at the late bud to full bloom stage were more effective on top and roots than those applied either prior to or after this critical stage. (3) 1-1/2 to 2-1/2 pounds of acid equivalent per acre produced economically significant results at the lowest cost per acre. (4) New scattered shoots were observed and frequently spot retreatments were necessary. In 1948 an attempt has been made to control the weed on a large scale with Ethyl ester of 2,4-D (Weedone concentrate 48) at the rate of 2 lbs./a. On July 23rd, 160 acres of summerfallow on the light sandy loam was treated at Saskatoon, Sask., with the weed population of 70 to 854 plants per square rod. With no retreatments, the land was sown to barley in 1949. Results: On October 3rd the top growth was 100% killed. Only 1% and 6% of new shoots were observed in higher places and in depressions respectively. The roots were discolored but not decomposed. Those of the green shoots were also abnormal but fully alive. On July 28th and 29th, 1949, 1.6% of surviving plants were found on the higher and 42 to 46% on the lower places. On October 3rd 1949 most of the plants on higher places were dead with their roots decomposed to a depth of 9 inches or more. In depressions, most of the plants were alive, but only occasionally produced heads with no viable seeds. Yield of barley was 22 bu./a. A heavy stand of barley probably has helped in the final kill of the surviving weeds. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Effect of various systemic herbicides on Canada thistle (Cirsium Arvense) in the late rosette stage, 1948, 1949. Thomas K. Pavlychenko. A vigorous infestation of Canada thistle at the late rosette stage was treated in duplicated plots with Weedone Concentrate 48 (Ethyl ester of 2,4-D), Weedone Standard (Ethyl ester of 2,4-D) and LFN549 (ester of 2,4,5-T) at rates of 8, 16, 24 and 32 oz./a. In addition LFN549 was used at 40 and 48 oz./a. rates. The above chemicals were further combined as follows: WC48+W5 - 8+8, 16+16 and 16+16 oz./a. rates; WC48+LFN549 - 8+8, 16+8, 8+16, 8+24, 16+16 and 16+24 rates; W5+LFN549 - 8+8, 16+16, 8+24, 16+16 and 16+24 rates; The infestation was solid with 110 to 128, 5 to 8 inch high shoots to a square yard. The soil was light sandy loam. Results: In 30 to 36 days the top growth was effectively killed in all plots. Forty-five days after treatment the new shoots began to appear in widely different numbers in all treatments. On October 11, 1948 the readings were taken. The lowest per cent of new shoots (5 to 25) was recorded in W5 plots; WC48 gave 28 to 64 per cent and the regrowth in the LFN549 plots was 9 to 60 per cent of the original stand in all cases, depending on the rates used. On October 9, 1949 the final readings were taken with the following

records on regrowth: WC5-8 to 13%, WC48-29 to 68% and LFN549-34 to 83% of the original stand. In plots where various combinations of 2,4-D and 2,4,5-T esters were used on this weed the average per cent of regrowth was slightly lower, yet the 2,4-D esters alone, particularly Weedone Standard, at higher rates (24 and 32 oz./a. gave the greatest reduction (92 and 89%) in this project. (Contribution of Agr. Div. American Chemical Paint Company, Saskatoon, Sask.)

Effect of various systemic herbicides on Canada thistle (Circium arvense) at the late bloom stage, 1948, 1949. Thomas K. Pavlychenko. One square rod plots in triplicate heavily infested with Canada thistle in the late bloom stage were treated on July 21, 1948 with Weedone Concentrate 48 (Ethyl ester of 2,4-D), Weedone Standard (Ethyl ester of 2,4-D), Weedone Standard (Ethyl ester of 2,4-D) and LFN549 (ester of 2,4,5-T) at rates of 8, 16, 24 and 32 oz./a. LFN549 was also applied at 40 and 48 oz./a/ rates. The infestation was from 5 to 55 plants per square yard and the soil was a light sandy loam. Results: On October 7, 1948 the lowest and the highest readings from triplicated plots with respect to the top kill were as follows: Weedone Standard 8 oz./a. 69 to 82%, 32 oz./a. 96 to 100%; Weedone Concentrate 48, 8 oz./a. 66 to 78%, 32 oz./a. 82 to 93%; LFN549, 8 oz./a. 62 to 67%, 32 oz./a. 91 to 92%. The rates of 40 and 48 oz./a. of LFN549 gave the top kill of 96 and 97% respectively. On October 5, 1949 the final readings were taken and the reductions in the original stands determined as follows: Weedone Standard, 8 oz./a. 82%. 32 oz./a. - 98%; Weedone Concentrate 48, 8 oz./a. - 74%, 32 oz./a. 91%; LFN549, 8 oz./a/ 75%, 32 oz./a. 87%. Only 5 and 2% of regrowth was observed in the 40 and 48 oz./a. rates respectively. In 1949 the plots were seeded to barley. A heavy stand of the crop was competing strongly with the weed plants and probably was a factor in suppressing the amount of regrowth. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Controlling Canada thistle (Circium arvense) with 2,4-D. Slife, F. W. and Fuelleman, R. F. Canada thistles seem to vary in regard to resistance to 2,4-D sprays. Some areas have been eliminated in one season while others have been sprayed twice a year for three years. Several areas were sprayed this year in June with 1-1/2 pounds of 2,4-D amine per acre. These were located in several sheep paddocks on the Animal Science Farm. One of these paddocks had been sown to Ladino clover earlier this season. The application of 2,4-D reduced the stand of Ladino approximately 50 per cent, but no thistles have reappeared during the season while adjacent patches were retreated in August. This is typical of the many reports we have received regarding variation in the reaction of Canda thistles to 2,4-D. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Effect of various herbicides on Canada thistle. Bakke, A. L. and D. M. Staniforth. Replicated plots of Canada thistle growing in oats where the stand of thistles was 25 plants per square yard were sprayed with 12 different herbicides. The first application was made in 1948 when the plants were in the early bud stage, July 3, the second on September 29, when the regrowth was 8 - 10 inches high. The third application was made on July 1, 1949 and fourth on Sept. 29. The results obtained had to be based on the results of three treatments. The compounds with an oil base like the pentachlorophenols produced very rapid kills of the above-ground parts but the regrowth the second year was so great that it was decided to use 2 lbs. per acre of an ester formulation of 2,4-D in 1949. Sodium chlorate, one pound per gallon and 4 gallons per square rod for the first application and one gallon for the second spray killed all vegetation. Ammate applied in the same amount was not as effective. On August 25, 1949 after three sprays of the sodium salt of

2,4-D there was an average of 26 plants to the square rod; the rate was one pound per acre. (Butyl) 2,4,5-T - 1/2 pound 23 plants, (Isopropyl) 1/2 pound 2,4,5-T-10 plants Dow Esteron 1/2 pound 14 plants, Weed-No-More 1/2 pound 13 plants, Tufor 40, one pound 11 plants. (Contribution Iowa Agricultural Experiment Station, Ames, Iowa.)

Reaction of weed perennials to Weedone Brush Killer 32. Heggeness, H. G. and Larson, A. H. One-half square rod plots of Canada thistle were sprayed in early summer with Weedone Brush Killer 32 diluted 1 to 50 with water. The amount of herbicide solution applied varied as follows: (1) Light coverage — plants sprayed lightly once; (2) Moderate coverage -- plants sprayed lightly twice; (3) Full coverage -- care taken to wet all aerial parts of the plant. Light and moderate applications caused distortions of the stem but did not kill the plants. Stem distortions also developed on thistles receiving full coverage but in this case the damage from the herbicide was permanent as the plants were dead after about four weeks. Natural infestations of wild rose, milkweed and leafy spurge were also sprayed with Brush Killer 32. Care was taken to thoroughly wet these plants. In each instance the weeds were killed. The data indicate that the degree of coverage with an herbicide is an important factor in the mortality of certain perennial weeds. (Contribution Minnesota Agricultural Experiment Station. St. Paul, Minnesota.)

Response of Canada thistle to herbicidal applications in three counties of Minnesota. Miller, John H. Square rod plots of Canada thistle, established in 1947, were sprayed once each season with the ester of 2,4-D, or the amine or sodium salt of 2,4-D using a rate of 30 gallons of solution per acre. The experiment was divided into two parts, a study of dosages, and a study of dates of application. Dosages of .5, 1, 1.5 and 2 pounds of acid per acre were uniformly applied at the bud stage of development. Dates of early spring, shooting to bud, and fall were sprayed with 1 pound of acid per acre. In Goodhue county, the full bloom stage was also included. Only two year's data are at hand since evaluation of results were based on spring to spring plant counts. From the data it is clear that none of the treatments effected complete eradication over the two year period. Results were not highly consistent at all three locations. In general, Canada thistle control varied from poor in Goodhue county to fair in Redwood county and was best in Douglas county. Certain treatments, however, consistently gave control at all locations although the degree of control varied. 1.5 pounds of amine salt gave consistent effective control at all locations. A dosage of .5 pound of amine or sodium salt did not appear to be sufficient for effective control, whereas, .5 pounds of ester was effective at all locations. The sodium salt failed to produce consistent results at all locations. Inconsistency was also apparent in the dates of application study. In only Redwood county was fair control obtained with early spring applications with all three formulations. Plants treated only in the fall regrowth stage were not satisfactorily controlled at any location or with any formulation. The full bloom stage (treated only in Goodhue county) failed to respond favorably. Thistles that were at or near bud stage of development responded more favorably in general to 2,4-D than thistles at other stages of growth. The ester formulation appeared more effective than the salts of 2,4-D for thistle control. (Contribution of U.S.D.A., Bureau of Plant Industry; Minnesota Agri. Exp. Station; Minnesota State Dept. of Agriculture, Dairy and Food; Minnesota Agri. Ext. Service; and Douglas, Goodhue and Redwood Counties.)

Response of Canada Thistle (Cirsium arvense) to 2,4-D at the end of one seasons cultivation. Warden, Robert L. Canada thistle in the rosetta stage was treated with 2, 4, and 6 pounds of 2,4-D acid in the monohydrate sodium salt, triethanolamine and butyl ester formulations. In addition 4 pounds of sodium salt plus a wetting agent and four pounds butyl ester in 2 gallon Diesel fuel per acre were used. Treatments were applied in triplicate on September 20, 1948, approximately 5 weeks after the last cultivation. The plants were growing under favorable moisture conditions and appeared vigorous. Results are based on spring emergence counts. All treatments reduced the number of thistles emerging in the spring to a considerable degree. The 4 and 6 pound rates of the amine reduced the stand to the greatest extent, with an average of 6 and 8 shoots respectively appearing on these plots as compared to an average of 69 shoots appearing on the check plots. The monohydrate sodium salt at rates of 2, 4 and 6 pounds and at 4 pounds with a wetting agent as well as the amine at 2 pounds, reduced shoot emergence to less than 20 per plot while all rates of the ester had average spring emergence of 22 to 42 shoots per plot. The amine appeared to have a distinct advantage over the other formulations and the 4 and 6 pound rates were better than the 2 pound rate under the conditions of this test. (Contribution of the Agronomy and Soils Dept. Montana Agricultural Experiment Station.)

Response of Canada Thistle (Cirsium arvense) to TCA. Lee, Oliver C. Plots of Canada Thistle were sprayed with TCA at rates of 60, 120, 240 pounds per acre in June of 1949. Plants at that time were in the early bud stage of growth. On one series of plots thistles were cut just prior to spraying. The spray was applied to the stubble and on the soil. Thistles on the other plots were not disturbed prior to spraying. On the plots where thistles were not cut all rates of application of TCA destroyed top growth. Resprouting occurred in 21 days on treatments of 60 and 120 pounds per acre. Normally healthy thistles were not apparent on plots treated with 240 pounds of TCA until approximately 90 days after spraying. Observations made in October indicate no reduction in stand of new growth on plots treated, regardless of rate, when compared to check plots. Weeds were clipped on check plots at the time of spraying. (Contributed by Department of Botany and Plant Pathology, Agric. Expt. Sta., Purdue University.)

Response of Canada Thistle (Cirsium arvense) to 2,4-D and 2,4,5-T. Lee, Oliver C. Square rod plots of Canada Thistle, in triplicate, were sprayed with an isopropyl ester of 2,4-D and 2,4,5-T in rates of 3/4, 1 and 1-1/2 pounds of acid per acre. Sprays were applied in June 1949 at which time plants were in the early bud stage of growth. Plants on plots sprayed with both 2,4-D and 2,4,5-T at the rate of 3/4 pounds per acre remained green for approximately 20 days after spraying. New growth developed some 60 days following spraying. Only a few plants produced flowers. No mature seeds developed. Top growth was killed more rapidly by applications of 1 and 1-1/2 pounds. Top growth was destroyed in 6 days on plots receiving applications of 1-1/2 pounds of 2,4,5-T. Very little resprouting occurred until the 1st of September. Although the difference was slight between the plots sprayed with 2,4,5-T and 2,4-D there appeared to be fewer new sprouts when 2,4-D was used than with 2,4,5-T. Some dead roots were found to a depth of 10-12 inches on all plots treated. Estimated reduction in stand expressed in per cent as determined by comparison to check plots the first of October is as follows: 2,4-D, 3/4 lbs. per acre 32; 2,4,5-T, 3/4 lbs. per acre 26; 2,4-D, 1 lb. 60; 2,4,5-T, 1 lb. 44; 2,4-D, 1-1/2 lbs. 64; 2,4,5-T, 1-1/2 lbs. 50. (Contributed by Department of Botany and Plant Pathology, Agric. Expt. Sta., Purdue University.)

The effect of treating and retreating Canada thistle in Grant County with three formulations of 2,4-D at three rates of application. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Square rod plots of Canada thistle were treated in duplicate with butyl ester, triethanolamine and the monhydrate sodium salt of 2,4-D at rates of k.4, 3/4. and 1-1/4 pounds of 2,4-D acid per acre. The original applications were made July 8, 1947 when the thistles were in full bud. Retreatments were made September 8, 1947 on the fall rosettes, July 10, 1948 when budding, September 15, 1948 on the fall rosettes, and July 6, 1949 when budding. Live plant counts were made on September 8, 1947, June 8, 1948, September 15, 1948, July 5, 1949, and August 26, 1949. Counts on treated plots were compared with untreated plots for per cent elimination. A delay in growth of the live plants on treated plots in comparison to untreated plots was indicated in June, 1948 and July, 1949. At the end of three years all chemicals at comparable rates were approximately equal except at the 1/4 pound rate. The sodium salt at 1/4 pound was materially lower in per cent kill than the other formulations at the same rate. The 3/4 pound rate of all formulations produced the highest per cent elimination after 5 treatments, however in no case was there 100 per cent elimination. These results would indicate that complete elimination of Canada thistle may not be accomplished by the use of 2,4-D and that this chemical can only be used as a control measure. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

The effect of treating and retreating Canada thistle in Butte County with 2,4,5-T and three formulations of 2,4-D at four rates, and in Lawrence County with 2,4,5-T and two formulations of 2,4-D at three rates. Kratochvil, D. E. and Lyle A. Derscheid. Randomized 1/2 by 1 rod plots of Canada thistle were treated in duplicate at the bud stage of growth in Butte County with 1/2, 3/4, 1, or 1-1/2 pounds of the butyl ester, triethanolamine or sodium salt of 2,4-D or 2,4,5-T. Randomized square rod plots of thistle were treated in Lawrence County with 3/4, 1, and 1-1/2 pounds of acid per acre of the butyl ester, or triethanol amine salt of 2,4-D or 2,4,5-T. The plots in Butte County were on idle grass land while those in Lawrence County were in a timothy hay field. The stand of timothy was heavy. Treatments were made on both sets of plots on the same date; June 19, 1948, with retreatments on September 18, 1948 and all plots retreated with 3/4 pound of amine on June 17, 1949. Plant counts were made on September 18, 1948, June 17, 1949, and August 29, 1949. Per cent elimination was determined by comparing untreated plots to treated. Results in Butte County showed the ester, amine and sodium salt formulations to be about equal at all rates except the 1/2 pound. Per cent elimination varied from 83.6% to 97.4%. The 2,4,5-T had a lower per cent elimination than the 2,4-D formulations at all rates except 1/2 pound. At this rate it had 82.3 per cent elimination compared to 71.8 for the ester, 65.3 for the amine, and 84.9 for the sodium salt. After three treatments on the timothy hay land in Lawrence County all rates of amine and ester showed 100 per cent elimination except amine at 1 pound which had 99.3 per cent control. The 2,4,5-T showed 82.5 per cent elimination at the 3/4 pound rate, 88.1 at the 1 pound rate, and 99.3 per cent at the 1-1/2 pound rate. The results of these plots indicate that competition of a thick stand of timothy in conjunction with 2,4-D may give better results than the use of the chemical only. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)

Use of 2,4-D in the control of Canada thistle (Cirsium arvense). Bohmont, Dale W. Randomized replicated, rod square plots were treated with 1/4, 3/4, 1-1/4 and 2 pounds of the ester, amine and sodium salt of 2,4-D in 1947 and retreated in 1948. All plots were treated at the bud stage of growth. Quadrat counts were taken after each treatment and the data computed on a percentage survival basis of the original

stand. The control resulting from two years' treatment was very poor regardless of materials or concentrations applied. The 2 pound amine treatment was significantly better than the other treatments with a 70.6 % kill after 2 applications. In Concentrations below 2 pounds, there was little or no kill resulting from the second year's treatment. It is apparent that under Wyoming conditions it is necessary to apply 2 pounds of 2,4-D or more over several years to obtain control of Canada thistle. (Contribution Wyoming Agricultural Experiment Station, Laramie, Wyoming.)

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Perennial Sow Thistle (Sonchus arvensis) Investigation leader: H.E. Wood

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Nine abstracts were received from six contributors, all from the Prairie Provinces, Canada. Five abstracts dealt with the control of sow thistle in cereal crops; four with eradication of the weed on land seeded to grass or land not under tillage. With the exception of two, the abstracts were confined to the use of 2,4-D; one abstract dealt with various commercial systemic herbicides offered by a well known company, the other non-commercial herbicides by the same firm.

Satisfactory control of perennial sow thistle treated in growing cereal crops was obtained, except in one trial where salinity of soil appears to have been a factor. No damage to crop occurred, while yields were increased by spraying due to reducing weed competition. Most satisfactory results followed treatment when the thistles had passed the rosette stage and were reaching the pre-bud to bud stage. Where treatment was delayed higher dosages were required, with the added problem of the crop reaching the heading stage when treatment must be further suspended; spraying after heading, while failing to remove the competition of the weed until too late to be advantageous, presents mechanical problems. Dosages ranged from 4 to 16 ounces acid per acre, with both the ester and amine formulations used. Higher rates and the use of the ester as compared with the amine gave upward trends in control. Depending upon local conditions, 8 ounces ester, and 12 or 14 ounces amine would seem about the maximum that should be used to control perennial sow thistle in cereal crops.

Trials in which 2,4-D has been applied to perennial sow thistle other than when in a growing crop of grain, indicated that a large measure of eradication is possible. Spraying for this purpose should be delayed until the thistles are in the flower stage. From one to two pounds acid of 2,4-D are recommended, with a preference for the ester.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACEOUS WEEDS

Abstracts of Results of Individual Cooperators.

Perennial Sow Thistle

Control of perennial sow thistle in oat crop with 2,4-D, 1942.
Brown, D. A. An area heavily infested with perennial sow thistle in a field of oats was used for this test. The soil was medium to highly alkaline and the grain crop was thin. Green Cross Ester (Weed-No-More) was used at rates of 4, 8, and 16 ounces of acid equivalent per acre. This was applied through a boom sprayer at 40 pounds pressure using seven gallons of water per acre. Treatments were done at two dates--June 12, July 12. Counts to determine thistle regrowth were made on six randomized squares four square feet in size on all treated plots and checks. June spraying killed back all above ground growth of thistle but revival was almost 100 percent within six weeks and crop was infested with headed thistles before it matured. July spraying effectively controlled all above ground growth and obviously weakened or killed many roots. Much crop was rolled down during July spraying. Yields were significantly lower on treated plots compared with checks. Crop was obviously injured at both dates and at all rates. Salinity of soil apparently influenced the reaction of the crop as oats in an adjacent field on soil relatively free of alkali salts remained uninjured after spraying at eight inches in height. (Contribution of the Dominion Experimental Farm, Brandon, Manitoba, Canada.)

The use of 2,4-D in the control of perennial sow thistle in barley.
Coupland, R. T. Rod-wide strips were treated on June 22, 1949, across a second crop barley field heavily infested with Sonchus on black loam soil (Prince Albert). At spraying, the weed was in the rosette stage and the barley was 6 inches high. Triethanolamine and isopropyl ester were used at 6 and 12 ounces per acre in 4 gallons of water. Twenty days after treatment, the weed, which was still in the rosette stage, showed greater curling and burning effects in ester treated strips. The barley averaged 17 inches in height. Data were recorded at harvest from nine plots, four square yards in area, in each strip on August 26. Yields of grain in untreated plots, amine at 6 and 12 ounces and ester at 6 and 12 ounces were 19.2, 21.2, 20.2, 19.6 and 27.0 bushels per acre, respectively. The last increase is significant at the 5 per cent point. Numbers of flowerstalks of Sonchus per plot averaged 95, 52, 13, 9 and 6, respectively, in the same treatments. The corresponding numbers of inflorescences per plot were 714, 338, 66, 57 and 26. The corresponding heights of Sonchus were 34, 29, 25, 24 and 21 inches, respectively. No differences were observed in height of the crop. Under the conditions of this experiment isopropyl ester was more effective than triethanolamine in controlling Sonchus. Six ounces of ester per acre was more effective than twelve ounces of amine in suppressing flowerstalk production, production of inflorescences, and height of flowerstalks of Sonchus. However, this decrease was sufficient to increase yield of grain only when 12 ounces of ester were used. These conclusions were corroborated from observations made on two other fields of barley in which the same experiment was conducted in the same district, one on stubble and one on summerfallow. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

The use of 2,4-D in the control of perennial sow thistle in spring wheat. Coupland, R. T. Rod-wide strips were treated on June 22, 1949, across a second crop wheat field heavily infested with Sonchus on black loam soil (Prince Albert). At Spraying, the weed was in the rosette stage and the wheat was 5 to 6 inches high. Triethanolamine and isopropyl ester were used at 6 and 12 ounces per acre in 4 gallons of water. Twenty days after treatment, treated weeds were still in the rosette stage (6 to 8 inches high), while untreated Sonchus averaged 17 inches in height and was in bud. At this time the wheat averaged 10 inches in height and some was in head. Data were taken at harvest from 10 plots, each 4 square yards in area, in each strip on August 25. Yields of wheat in untreated plots amine at 6 and 12 ounces and ester at 6 and 12 ounces, were 6.2, 7.0, 9.7, 13.3, and 15.3 bushels per acre, respectively. Numbers of flowerstalks of Sonchus per plot averaged 121, 52, 19, 8 and 7, respectively, in the same treatments. The corresponding numbers of inflorescences per plot were 559, 199, 108, 42 and 40, and the corresponding heights of Sonchus were 39, 31, 22, 18 and 20 inches. Height of wheat was unaffected. Under the conditions of this experiment isopropyl ester was more effective than triethanolamine in controlling Sonchus. Six ounces of ester per acre were more effective than 12 ounces of amine in decreasing flowerstalk production, production of inflorescences and height of flowerstalks. Increased yields of wheat were significant at the 5 per cent point with 6 ounces of ester and at the 1 percent point with 12 ounces of amine or ester. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

The effect of 2,4-D on perennial sow thistle in spring sown wheat. Friesen, H. A. The amine and ester formulations of 2,4-D were applied at four rates; namely, 4, 6, 8, and 12 ounces acid per acre to perennial sow thistle. The treatments were made at three stages of weed growth; namely, (1) when 2 to 4 inches tall (2) when 6 to 8 inches tall, and (3) when in early bud. Complete top growth kills of perennial sow thistle resulted at the first two treatment dates where the 6, 8, and 12 ounce rates of ester and the 8 and 12 ounce rates of amine were used. Regrowth and new growth was light and slow, only a few scattered plants advanced to the flowering stage. Regrowth was not abundant until late August. The effect of these treatments was to materially reduce the competition of this weed and permit near weed free conditions for crop growth. The lower rates were effective only in retarding the thistle development for some two weeks. The 8 and 12 ounce rates of ester and 12 ounce rate of amine resulted in fair top growth kills of sow thistle in the early bud stage and prevented flowering. This stage, however, was rather late to appreciably limit their competition with the crop, this was particularly true where the patches were heavy. (Contribution of the Dominion Experimental Station, Scott, Saskatchewan, Canada.)

Effect of two 2,4-dichlorophenoxy acetic acid formulations on sow thistle in crop (Olli Barley) sprayed at 2 stages of growth using 3 different rates. Leggett, H. W. The formulations used were triethanolamine and butyl ester. The stages were as follows: (1) Rosette to pre-bud in almost equal numbers. (2) Full bloom. Very dry conditions in the early part of the season were responsible for the numerous stages present under stage 1 which were sprayed after moisture was received and under ideal growing conditions. The rates used were 4, 8, and 12 ounces of acid per acre on triplicate plots 10 feet by 10 rods. 5 (square yard) weed counts were taken from each plot and tabulated as follows: (1) Complete top growth kill. (2) Top growth control (stunted, and producing no seed). (3) Unaffected. The results gave excellent control of sow thistle in the stages sprayed under stage 1, no significant difference being found between formulations or rates although the tables show a slight upward trend for rates

and also between the amine and ester formulations in favor of the ester. The percent top growth killed and controlled in stage 1 giving from 96.2% to 100% control. The results in stage 2 (the full bloom stage) show only partial control in all but the 12 ounces of ester. The results in all of the amine plots show only a 40 percent control; some factor as yet not known may be responsible as the trend is downward with an increase in rate. The results of the ester formulation show an upward trend with increase in rate, from 56.7 percent to 100 percent control. The Olli barley crop showed no adverse effects on any of the plots. (Contribution of Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada.)

Large scale control of perennial sow thistle with ethyl ester of 2,4-D, 1948, 1949. Pavlychenko, Thomas K. Eighty acres of summerfallow on a light sandy loam soil at Saskatoon, Saskatchewan, were treated on July 23, 1948, with ethyl ester of 2,4-D (Weedone concentrate 48) at a rate of 2 pounds of acid equivalent per acre. The infestation was from 228 to 1618 plants per square rod and the weeds in the late bloom stage. On October 3, 1948, the top growth was 100% dead and most of the roots decomposed. Only in depressions 2% to 3% of the shoots were observed. With no retreatments, the land was sown to barley in 1949. On the 30th and 31st of July, 1949, only occasional surviving plants were found on the higher places, and up to 10% in the depressions. In check strips the infestation was solid, frequently to the exclusion of barley. On October 3, 1949, the final counts were taken and the results were as follows: the higher places were virtually free of weeds. In depressions, from 9% to 14% of the surviving plants, all in a rosette stage, were recorded. In check strips from 266 to 1498 plants to a square rod were counted. Yield of barley over the treated area averaged 22 bus./a. It is felt that the heavy stand of barley under relatively dry conditions of 1949 has helped in the final kill of the surviving weeds. (Contribution of the Agricultural Division, American Chemical Paint Company, Saskatoon, Saskatchewan, Canada.)

Effect of various systemic herbicides on perennial sow thistle at the late bloom stage, 1948, 1949. Pavlychenko, Thomas K. Forty plots, one square rod in size, heavily infested with perennial sow thistle on light sandy loam at Saskatoon, Saskatchewan, were treated on July 23rd, 1948, with Weedone Standard (ethyl ester of 2,4-D)Weedone Concentrate 48 (ethyl ester of 2,4-D) and LFN549 (ester of 2,4,5-T) at rates of 8, 16, 24, and 32 ounces per acre. In addition, LFN549 was used at 40 and 48 ounces per acre rates. The plant population was 9 to 61 per square yard in the late bloom stage. Results: 75 days after treatments the top growth was 100% killed in all plots treated with 24 ounces per acre rates or more. In plots treated with 16 ounces per acre rates or less some of the bottom leaves were polish green. The season was extremely dry and the new shoots were virtually absent in all plots with the exception of three plots all located in a depression. LFN549 was conspicuously less effective in killing both the top and particularly the roots of this weed. In October of 1949 the regrowth came up heavily in 8 ounce per acre rates of all the chemicals used. No shoots were observed in the Weedone Standard plots of 16 ounces per acre or more, 33, 12, and 0% were found in the Weedone Concentrate 48 plots if 16, 24, and 32 ounces per acre respectively, and 42, 18, 13, 14 and 13% of regrowth was recorded in the LFN549 plots treated with 16, 24, 32, 40 and 48 ounces per acre rates respectively. Weedone Standard was by far the most effective chemical used in this project. (Contribution of Agriculture Division, American Chemical Paint Company, Saskatoon, Saskatchewan, Canada.)

Effect of various non-commercial systemic herbicides on perennial sow thistle treated prior to or soon after the shoots emerged, 1949. Pavlychenko, Thomas K. In this experiment an attempt has been made to find out the effect of several non-commercial systemic compounds on perennial sow thistle if applied to the soil prior to or soon after the shoots began to appear. The laboratory formulations labelled ACP 675, 646, 472, 648, 649 and 638, all 2,4-D compounds, were tried at 1 pound per acre rates. ACP 644 (the IPC formulation) 1 pound per acre was tested and TCA (sodium trichloroacetate) at 20 pounds per acre rate was also included. All plots were provided with alternating checks in order to observe the results and conveniently compare them with the checks on both sides. Results: ACP 675 gave 80% top kill with 20% of plants strongly affected but alive and 15% of new shoots; ACP 646, 94% top kill, 6% survival and 8% regrowth; ACP 649, 100% top kill, 11% regrowth; ACP 644 (IPC), 30% top kill, 37% survived but strongly affected and 33% normal; Agroxone, 8% top kill, 50% variously affected but alive, and 42% normal; TCA, 20 pounds per acre, 40% kill, the remaining 60% were variously affected and could not be considered normal, although alive, 14% regrowth; ACP 472, 100% top kill, 25% regrowth; ACP 648, 100% top kill, 30% regrowth; ACP 638, 93% top kill, 7% very strongly affected, no regrowth. In check plots the weeds were normal with population of 18 to 64 plants per square yard. (Contribution of Agriculture Division, American Chemical Paint Company, Saskatoon, Canada.)

Eradicating perennial sow thistle with 2,4-D. Wood, H. E., J. J. Bourns, and J.C.E. Fuller. Tenth-acre plots were located on a field of clay soil, near Portage la Prairie, seeded to brome grass in 1947, and carrying a moderately heavy infestation of perennial sow thistle. These plots were machine sprayed July 27, 1948, using 5 imperial gallons water per acre, with various formulations of 2,4-D mostly at the rate of 1 pound acid per acre, when the thistles were well advanced in flower. Examination through the fall months of 1948, and the early summer of 1949 until July 26, when the final check was made, revealed almost complete eradication of thistle. The following points were noted: (1) that bud to early flower would seem the period at which treatment should be made; (2) that about 1 pound acid per acre would seem the required dosage; (3) there appeared to be little difference between the ester and the amine formulations; (4) that 2,4,5-T proved ineffective. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

PROJECT I USE OF HERBICIDES IN CONTROL OF HERBACEOUS PERENNIAL WEEDS.

Hoary Cress Investigation leader: J. W. Zahnley

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Results of applications of herbicides on hoary cress were reported from six locations, one in Wyoming, one in Kansas, one in Manitoba and three in Saskatchewan. At three of the six locations complete eradication was accomplished by repeated application of 2,4-D on hoary cress in uncultivated land. At each of these, less satisfactory results were obtained with treatments of the weed on cultivated land. Apparently hoary cress is more easily killed when growing in grass sod. Two investigators regarded 2 pounds of acid per acre as the minimum dosage while two others obtained good results with 4 pounds. A mixture of 2,4-D with 50 and 75% 2,4,5-T gave no better results than 2,4-D alone. In general the esters seemed to be preferred but in one case the amine was slightly, though not significantly, better. Applications of atlacide and of sodium chlorate at rates of 600 to 800 pounds per acre had to be repeated three to four times to kill hoary cress and such treatment left the soil sterile for four years.

Abstracts of Results of Individual Cooperators.

The use of 2,4-D in the control of hoary cress (Cardia pubescens). Bisal, F. One plot of hoary cress was treated in 1946 with Weedone at the rate of 1500 ppm. There was a regrowth in 1947 after which it was sprayed in June 1947 at the rate of 4 lbs. of the ester of 2,4-D in 4 gallons of oil per acre. On July 10, 1947, it was again treated with 4 lbs. of the ester of 2,4-D in water. There were no plants on this plot in 1948 or in 1949. The plot was not cultivated at any time. Plots which had been treated with 2,4-D since 1946 and cultivated every year show very different results. There is some reduction in the stand but this is not easily determined on the perennials. The plots treated in 1949 with 2,4-D show a kill of the top growth but roots not affected. Results are the same as in previous years. (Contribution of Dominion Soil Research Laboratory, Swift Current, Saskatchewan.)

Use of 2,4-D in the control of white top (Lepidium draba). Behment, Dale W. Randomized, replicated, rod square plots in native pasture were treated to compare the effect of different types and concentrations of 2,4-D at the bud stage of growth. Plots were treated in 1947 and again in 1948. Quadrat counts were taken after each treatment, and the data was computed on a percentage survival basis. A comparison of the ester, amine and sodium salt of 2,4-D at concentrations of 1/4, 3/4, 1-1/4 and 2 pounds over a three-year period indicate a significant difference between concentrations. After two applications, the 2 pound treatment was significantly better than any other concentration in all types of 2,4-D. The 2 pound amine had a smaller per cent survival than any of the other types of 2,4-D; however, it was not statistically significant. It is apparent that under Wyoming conditions, the 2 pound concentration is far superior to any lesser amount, and that over two years is necessary for adequate control. (Contribution of the Wyoming Agricultural Experiment Station)

The use of herbicides for the control of hoary cress (Lepidium draba). Brown, D. A. Atlacide. This was applied to a heavy infestation of hoary cress at 200, 400, 600 and 800 pounds per acre dissolved in water and sprayed at 400 gallons (imperial) per acre. Single applications were compared with applications repeated in June, August, September and the following June. Only at 600 and 800 pound rates repeated three to four times was a satisfactory eradication obtained. The soil was rendered sterile and failed to produce grain crops for four years. Sodium Chlorate applied in similar fashion to Atlacide gave comparable results. 2,4-D. Plot experiments extended from 1945 to 1948. Applications of butyl ester, amine and sodium salt were made at rates of 1/2, 1 and 2 pounds acid equivalent per acre in single treatments at the following stages of growth (1) spring rosette, (2) bud, (3) full bloom, (4) post bloom, (5) fall regrowth. Single treatments were compared with treatments repeated each time single treatments were made. Only the plots receiving the repeated dosages showed satisfactory killing. Counts of plants surviving made throughout one year after treatments showed five repeated sprayings gave 90 to 100 per cent kill. In 1949 large areas of hoary cress were sprayed with butyl ester at 4 pounds acid per acre on June 20 (full bloom). All top growth was killed within ten days and absolutely no regrowth occurred until early October. Regrowth at this time while weak was sufficient to reinfest the area. (Contribution of the Dominion Experimental Farm, Brandon, Manitoba.)

Response of hoary cress (Lepidium draba) to herbicides. Coupland, R. T. Unreplicated plots of hoary cress 10 by 7 feet in size were treated on silty clay loam in the dark-brown soil zone at Saskatoon during the dry summer of 1948 with ethyl ester of 2,4-D and with 50 and 75 per cent mixtures of this with 2,4,5-T at 1, 1.5 and 3 pounds of acid per acre in 5 gallons of water. Solid infestations of the weed, averaging 264 shoots per square yard, were treated on June 29 when in flower. The temperature was 78° F., the sky was clear and an 18 M.P.H. wind was blowing. Recounts made one month after treatment showed reductions in stand varying from 40 to 75 per cent and averaging 53 per cent. No apparent advantage of one chemical mixture over another or of the highest rate over the lower ones was observed. Subsequent regrowth followed and the treatment was repeated in late September using the same chemicals at the same rates. The ineffectiveness of these treatments in controlling the weed was shown by the vigorous, dense stands occurring during 1949, which could not be distinguished from those on control areas. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

The effect of 2,4-D on toadflax (Linaria vulgaris) and hoary cress (Lepidium draba). Friesen, H. A. In 1949 the ester and amine formulations of 2,4-D at rates of 1/2, 3/4, 1, 2 and 3 pounds of acid per acre were sprayed on toadflax in the spring rosette and in the first bud stages. While a fair degree of top growth control resulted from all treatments, recovery of treated plants occurred within two to three weeks on all but those plots treated with the ester at rates in excess of one pound per acre. On these plots the top growth was 80 percent killed, however, the roots appeared to be killed to a depth of only 2 to 3 inches below the surface. Consequently, by mid August regrowth appeared to be even more abundant than the original stand. The poor kills may have been due to the severe drought in the spring and early summer at Marsden, Sask., where the tests were conducted. Similarly, poor kills

PROJECT I USE OF HERBICIDES IN CONTROL OF HERBACEOUS PERENNIAL WEEDS.

Field Bindweed Investigation leader: J. W. Zahnley

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Sixteen abstracts of reports on bindweed control were received from seven individuals or teams. Seven of the abstracts were accompanied by tabular data. The results reported show that good control of bindweed is accomplished by applications of 2,4-D. Complete elimination, however, has occurred in only a few instances in these tests. Evidence of this fact is shown in a summary of five years results with 2,4-D on bindweed at Hays, Kansas, 1945 - 1949 which is included herewith. Favorable growing conditions and abundant top growth at the time of treatment are essential for effective results. When such conditions exist, late fall treatment has given better results in some instances than earlier applications. Chemical treatment is more effective when used in combination with a good competitive crop such as perennial grass. There appears to be no significant difference in the ultimate effect of the different formulations of 2,4-D on bindweed after repeated treatments, although greater reduction in stand may be obtained by the esters from the first application. Results from application rates of 1/2 pound to 4 pounds of acid per acre indicate that under favorable conditions 1 pound of acid is sufficient for maximum kills of bindweed. One report showed that diesel fuel used as the carrier gave no better results than when water alone was used. Three reports of comparisons of 2,4-D and 2,4,5-T show that the latter is no more effective on bindweed than 2,4-D.

Abstracts of Results of Individual Cooperators.

The effect of treating field bindweed in Lawrence County with 2,4,5-T and three formulations of 2,4-D at four rates of application. Kratochvil, D. E. and Lyle A. Derscheid. Randomized 1/2 rod by 1 rod plots of field bindweed were treated in duplicate with the butyl ester triethanolamine salt, and sodium salt of 2,4-D and with 2,4,5-T at the rates of 1/2, 3/4, 1 and 1 1/2 pounds of the acid per acre when the bindweed was budding. Treatments were made on June 18, 1948. Live plant counts were made June 16, 1949 and the treated plots were compared with untreated to obtain per cent kill. Live plants appeared stunted on all treated plots at the time the counts were made. Formulations varied at comparable rates except at the 1 pound rate. 2,4,5-T gave a materially higher per cent kill than the amine or sodium salt at the 1/2 and 1 pound rate. At no rate did the per cent elimination by 2,4,5-T equal that of the butyl ester. The sodium salt showed 81.8 per cent elimination at the 1 1/2 pound rate. This was the highest per cent elimination in the experiment. Results here indicate little difference in formulations however rates required may vary. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)

Effect of 2,4-D on field bindweed (Convolvulus arvensis). Slife, F. W. and Fuelleman, R. F. Although 2,4-D is very effective in controlling field bindweed it has not eliminated it except with repeated applications over a period of years. Applications of 2,4-D made on bindweed in the prebloom stage has given control throughout the season with very little regrowth until the following season. Applications of 2,4-D in midsummer or fall have not been as

effective as the prebloom application in the spring. Some bindweed plots have been treated for 3 years in the prebloom stage and there seems to be considerable regrowth on these plots. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois)

Results of three years of 2,4-D on field bindweed in bluegrass sod. Shafer, N. E. A uniform experiment started in June 1947 has been continued through the fall of 1949. Three formulations; amine and sodium salts, and butyl ester were sprayed at rates of 1#, 2#, 3#, and 4# acid per acre. The bindweed was sprayed twice each year, once at the early bloom stage and again on the fall regrowth. Final stand counts reveal the following comparisons of percentage kill: average of all three formulations 1# - 88.0%, 2# - 84.0%, 3# - 85.5% and 4# - 87.83%. Average kill for all four rates of each of the three formulations are as follows: amine salt 90.87%, sodium salt 81.62% and butyl ester 86.50%. This appears to indicate that there is no advantage for rates of 2,4-D above 1# on field bindweed and at the end of three years and six applications there appears to be some advantage for the amine salt. (Contribution of the Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska)

Response of field bindweed (Convolvulus arvensis) to herbicides. Coupland, R. T. Unreplicated plots of field bindweed 10 by 7 feet in size were treated on silty clay loam in the dark-brown soil zone at Saskatoon during the dry summer of 1948 with ethyl ester of 2,4-D and with 50 and 75 per cent mixtures of this with 2,4,5-T at 1, 1.5 and 3 pounds of acid per acre in 5 gallons of water. Solid infestations of the weed, averaging 69 shoots per square yard, were treated on June 29 when in flower. The temperature was 78° F., the sky was clear and an 18 m.p.h. wind was blowing. Recounts made one month after treatment showed reduction in stand varying from 68 to 92 per cent and averaging 85 per cent. Two months after treatment the reduction ranged from 66 to 95 per cent and averaged 75 per cent. No apparent efficiency of one chemical mixture over another was observed. The same plots were retreated in late September with the same chemicals at the same rates. The ineffectiveness of these treatments in controlling the weed was shown by the vigor of the stands in 1949, which, although sparser than the controls, were not affected greatly by the treatments. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

The relation of stage of growth and rate of application to the effectiveness of field bindweed control with 2,4-D. Experiment started in 1946. Phillips, W. M. The sodium and amine salts of 2,4-D were applied at 1,2,3, and 4 pounds per acre on bindweed at complete emergence, bud, full bloom and fall regrowth stages in 1946. In addition an ester was applied at these rates at bud and fall regrowth. These treatments were repeated in 1947, 1948, and 1949 at corresponding stages and rates.. Fall applications made in 1946 under favorable moisture conditions resulted in a greater reduction of stand than any of the spring treatments. Dry weather prevailed in the fall of both 1947 and 1948, and, as a result, after three treatments, the fall treated plots now have more bindweed than those treated in the spring. The rates and formulations used have given substantially equal results. Until after the 1948 retreatment the bud and bloom treatments appeared more satisfactory than applications made at complete emergence. Since that time there has been no apparent difference. This experiment is being continued to see whether or not

eradication can eventually be achieved. In the fall of 1949 one treatment, 1 pound amine applied at the bud stage had no apparent regrowth. None of the spring treatments had more than 2 percent of the original stand. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

The relation of stage of growth and rate of application to the effectiveness of field bindweed control with 2,4-D. Experiment started in 1947. Phillips, W. M. An amine and sodium salt were applied at 1,2,3, and 4 pounds per acre, and an ester at 1/2, 1, 2, and 3 pounds on bindweed at complete emergence, first bud and full bloom. Original applications were made in 1947 and retreatments were applied at corresponding rates and stages in 1948 and 1949. Five treatments, 1 and 2 pounds sodium salt applied at full bloom, 3 pounds sodium salt at complete emergence, and 1 and 2 pounds amine at the bud stage, still have an average of more than 10 percent regrowth. One of the replicate plots of each of these treatments is in every case responsible for the high average survival. These plots were all in an area of approximately 5 sq. rods where no treatment was wholly effective. No explanation is offered concerning this poor control. Except in the area mentioned all of the rates used appear to be sufficiently high to give approximately the same degree of control. Neither stage or formulation has had any apparent effect on the results obtained. Little progress toward complete eradication was attained in 1949, in some cases the percent regrowth was slightly greater in the fall of 1949 than in the fall of 1948. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas)

The relation of stage of growth and rate of application to the effectiveness of field bindweed control with 2,4-D. Experiment started in 1948. Phillips, W. M. An ester at 1/2, 1, 1 1/2, and 2 pounds per acre and an amine at 1, 1 1/2, 2 and 3 pounds per acre were applied on triplicate plots of bindweed at complete emergence, first bloom, full bloom, and fall regrowth in 1948. Retreatments at the same rates and stages were made in 1949. Treatments in the dry fall of 1948 were not so effective as those in the spring of 1948. All treatments except 1/2 pound ester and 1 1/2 pounds amine had a larger number of surviving plants in the fall of 1949 than were recorded in the fall of 1948. The reason for the apparent ineffectiveness of the 1949 treatments is not known, but the fact that over eight inches of rain fell between the spring treatments and July 1 is the only tangible factor which deviated greatly from normal. On the average there is very little difference between the three spring dates of application, and the higher rates do not appear to give more satisfactory results. Average reduction in stand of all rates of ester and amine on all dates show a difference of only 1.3 percent in favor of the amine. Although the rates are not exactly comparable the lower rate of ester and the higher rate of amine did not greatly affect the average results. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

The relation of stage of growth and rate of application to the effectiveness of field bindweed control with 2,4-D. Experiment started in 1949. Phillips, W. M. Triplicate plots of bindweed were sprayed with an ester and amine of 2,4-D at 1/2, 3/4, 1 and 2 pounds per acre at the early bud, bloom, and fall regrowth stages of growth. No data are available from the fall

applications and results from the spring treatment are preliminary in nature. Applications made in 1949 were somewhat less effective than those made in previous years. Reduction in stand varied from an excellent 90 percent to only 55 percent with most of the treatments giving less than 75 percent reduction. Applications made during the early bud stage gave a greater reduction than those made at the bloom stage. This might be explained by the presence of a beetle on the plants which caused a great loss of vigor shortly before the plants bloomed. One pound of ester gave the greatest reduction of bindweed and in general the esters gave slightly better results. No definite trends concerning optimum rates were established. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

Field bindweed control with 2,4-D combined with intensive cultivation and competitive crops. Phillips, W. M. Experiments started in 1946, 1947, 1948, and 1949 indicate that more satisfactory control of bindweed may be attained through the combined use of 2,4-D, intensive cultivation, and competitive crops than with 2,4-D alone. Although the work has been carried out for a number of years, it is felt that the data are still inconclusive. 2,4-D applications were made at the rate of 1 pound per acre on non-cropped plots and 1/2 pound per acre in growing crops. In the drier portions of the Great Plains lack of soil moisture during the late summer and early fall many times inhibits bindweed growth in the fall. In seasons with rainfall adequate for good fall growing conditions a fall application of 2,4-D followed with a close drilled crop in the spring has given excellent controll. Drilled sorgo following either a fall or spring application of 2,4-D has been the most effective competitive crop,. with spring oats or barley slightly less satisfactory. Fall applications of 2,4-D on winter wheat have reduced the wheat yields seriously. Spring treatment in small grain has reduced the stand of bindweed effectively but has reduced the yield in some cases. 2,4-D treatment either in the fall or spring followed by sorghum planted in rows has not been so effective as other methods. Some of the plots are cultivated intensively when the land is not in crop. This appears to be advantageous in controlling the bindweed. (Contributed by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A., Hays, Kansas)

The effect of intensive cultivation before and after spraying bindweed with 2,4-D. Phillips, W. M. Experiments involving six treatments on duplicate plots were started in 1947, 1948, and 1949 in an attempt to find the effect of 2,4-D on bindweed when combined with intensive cultivation. The plots were sprayed with an ester of 2,4-D at 1 pound per acre. Intensive cultivation was done with a sub-surface tiller at 14 to 18 day intervals, or as the growth of bindweed demanded. No appreciable difference between treatments were noted in the experiment started in 1947. Eradication is virtually complete on the plots receiving 2,4-D with no intensive cultivation, as well as on the plots that were cultivated after spraying, cultivated for 1,2, and 3 months and then sprayed, or cultivated without 2,4-D treatment. Similar results are being obtained from the experiment started in 1948, although eradication is not being accomplished so rapidly. At the close of the 1949 season treatments involving two or three months of intensive cultivation before spraying appeared to have a slight advantage over the other treatments started in 1948. The 1949 experiment has not progressed far enough to establish appreciable differences. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas)

A summary of five years' results of spraying field bindweed with 2,4-D at Hays, Kansas. Phillips, W. M. New experiments were begun each year from 1945 to 1949 to test the relative effectiveness of various rates of 2,4-D on bindweed when applied at different stages of growth. Rates used in the earlier work were higher than are now believed necessary, but these experiments have nevertheless yielded valuable information. One treatment with 1 pound or more of 2,4-D has given from 70 percent to 90 percent reduction in stand in most cases. One retreatment each year has further reduced the stand, with the exception of the 1949 retreatments. Complete eradication of the established plants has seldom been attained even with as many as four treatments. Results to date indicate that satisfactory control may be obtained by spraying any time the bindweed is fully emerged and growing vigorously. Treatments applied during periods of near dormacy due to lack of soil moisture have not been as effective as when applied under more optimum growth conditions. Although not consistently so, a single application of ester has given greater reduction in stand than a single treatment with the sodium or amine salts. The latter have been fully as effective when retreatments were applied, and since retreatment is always necessary there appears to be no advantage of one formulation over another. No 2,4-D treatment is satisfactory under adverse growing conditions although the esters are better than the salts. If treatment can be made under favorable conditions, it is believed that approximately 1 pound 2,4-D acid per acre of either the ester or the salts will give maximum kill of bindweed. If the amine or sodium salt is used under less favorable conditions 1 1/2 pounds is recommended. During periods of extremely high temperatures accompanied by sufficient soil moisture for rapid plant growth 3/4 pound of the ester formulation is considered adequate. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

Control of field bindweed with 2,4-D and bromegrass as a competitive crop. Zahnley, J. W. and G. L. McCall. An area fully infested with bindweed was plowed July 25 and a heavy regrowth of the weed treated October 1, 1947 with one pound of 2,4-D acid in the ester form. Only 5% of the original stand had emerged by April 25, 1948 when the area was seeded to bromegrass. On June 10 duplicate plots of 1/20 acre each were treated with 2,4-D ester, triethanol amine, and monohydrate sodium salt at rates of 1/2 and 3/4 pounds of acid per acre. On August 15 all plots were mowed and a heavy growth of crabgrass and some brome was removed and all plots retreated October 1, 1948. At that time the stand of bindweed had been reduced to less than 2% of the original stand. In the spring of 1949 the bromegrass took possession of the area and only a trace of bindweed remained. The area was mowed July 25 and in October very few bindweed plants could be found for spot treatment. At that time there was no significant difference in the effectiveness of the esters, amines and salts nor in the 1/2 and 3/4 pound rates. (Contribution of the Kansas Agricultural Experiment Station.)

The comparative effects of fall treatments 2,4-D and 2,4,5-T upon field bindweed, Convolvulus arvensis. McCall, G. L. and J. W. Zahnley. Replicated plots of bindweed were treated on October 22, 1948, with the isopropyl esters of 2,4-D or 2,4,5-T. The 2,4-D was applied at rates of 1, 2 and 3 lbs. of acid per acre and the 2,4,5-T was applied at the rate of 2 lbs. of acid per acre. Each treatment was applied in straight water, straight diesel fuel and in a fifty-fifty mixture using a volume of 40 gallons per acre. Results were excellent with an average reduction in stand for all treatments of more than 90%. Two and three pounds of 2,4-D acid per acre were no better than, if as good as 1 lb. of acid per acre. Their average reduction in stand being less

than that of the 1 lb. rate. 2,4,5-T treatments were no better than comparable treatments of 2,4-D. On the average, they tended to allow a somewhat larger percentage regrowth of bindweed. The straight diesel fuel or the fifty-fifty water diesel fuel mixture were no better than straight water when used as the media for applying 2,4-D or 2,4,5-T. (Contribution of the Kansas Agricultural Experiment Station)

Use of 2,4-D in controlling field bindweed. Uniform Project I, 1948. Woestemeyer, V. W. In 1948 duplicate square rod plots of bindweed were sprayed with sodium salt, amine and ester formulations of 2,4-D at rates ranging from 1/2 to 3 pounds per acre acid equivalent. Applications were made at late bud (May 17), early bloom (June 9), and late fall (October 10) stages of bindweed growth. Retreatments were made in 1949 according to the original plan. Plant counts were made 90 days after bud and bloom treatments and a year after the fall treatment. The spring of 1948 was unusually dry and bindweed was not in a succulent condition at the bud stage and was still less favorable at the bloom stage. There was 63 per cent re-emergence from spraying in the bud stage and 138 per cent from the bloom stage in 1948. Of the three dates of treatment in 1948, the fall applications resulted in an average of 52 per cent regrowth which is less than the earlier treatments as given above. Growing conditions were favorable in the fall. 1949 average counts showed no consistent advantage for heavier treatments over light treatments, although there is an indication of this in the bud stage with sodium salt. Esters show an average regrowth of 27 per cent compared with 32 per cent for salts and 34 per cent for amines. The advantage for esters was apparent primarily at bud stage. Bud and bloom treatments both averaged 21 per cent regrowth after the second treatments. Counts will be taken on the 1949 fall treatments in 1950. (Contribution of Kansas Agricultural Experiment Station)

A comparison of the effectiveness of different commercial preparations of 2,4-D in eradicating field bindweed. Woestemeyer, V. W. Eight commercial preparations of 2,4-D including three salts, two amines, two esters and one acid were compared as sprays at the rate of two pounds 2,4-D per acre on duplicate square rod plots of field bindweed. Original applications were made May 27, 1946, on a uniform stand of bindweed in the rapid growth-bud stage. Retreatments have been made at the same rate and period of growth each following year. Plant counts were made ninety days after each treatment.. Counts in 1946 showed from 7.8 per cent to 13.9 per cent of the original plants remaining with the esters and acid averaging slightly better kills than amines and salts. There was little change in the 1947 count. In 1948 further reductions were obtained on all plots with no apparent advantage for any type of formulation. Each of three formulations had eradicated field bindweed on one of the duplicate plots. In 1949 no regrowth was observed after treatment on either of the duplicate plots for three formulations, and all but one of the five other formulations had completed eradication on one of the duplicate plots. Soil moisture was sufficient prior to spraying each year except 1948 which was unusually dry. (Contribution of the Kansas Agricultural Experiment Station)

Use of borax compounds in eradicating bindweed. Woestemeyer, V. W. Borascu and concentrated borascu were applied dry to duplicate square rod plots on a heavily infested area of bindweed March 31 before emergence began. Borascu was applied at 26, 30 and 34 pounds per square rod and the concentrate applied at from 12 to 20 pounds per square rod. No bindweed emerged until

midsummer when occasional plants began to appear. By fall, some was present on all treatments except 20 pounds of concentrate but no treatment averaged over .5 per cent regrowth as compared with the 1200 plants on the check plots. Two soluble materials, Polybor and Polybor-chlorate, were applied to duplicate 100 square foot plots as sprays at rates of 3, 6, 8 and 10 pounds per 100 square feet in concentrations of 1-1/2 pounds material per gallon of water. Applications were made June 6 on good bindweed growth. In two or three days bindweed top growth was dead on all except the 3 pound plots which required a few more days. Re-emergence began in a month on all 3 pound plots, and in two months on the other plots. Two date there appears to be no advantage for P-C over Polybor. On October 10 regrowth on P-C plots was 15, 3, 2 and 1 per cent of checks for 3, 6, 8 and 10 pound plots respectively. Regrowth on Polybor plots was 11, 4, 2 and trace for the same rates. Checks averaged 400 plants per 100 square feet. The 3 pound rates of both materials may be below the optimum but there is little advantage in increasing rates above six pounds. (Contribution of the Kansas Agricultural Experiment Station)

PROJECT I. Use of Herbicides in Control of Perennial Herbaceous Weeds.

Leafy spurge Investigation leader: Thomas K. Pavlychenko

Summary

Twelve separate reports of the work with leafy spurge were submitted for this summary, four from Western Canada and eight from the North Central States area, including one from Montana. The principal chemicals used were 2,4-D; 2,4,5-T; various mixtures of the two; amate; mixtures of amate and 2,4-D; borascu; razorite; polybor and polybor-chlorate. In some cases the chemical treatments were preceded or followed by various types of cultivation and in others the chemically treated areas were reseeded to grass.

2,4-D treatments. Rates from 8 oz./a. to 30 lbs./a. with many intermediate dosages were used at various places. Amine and sodium salts and esters of 2,4-D were applied. The results show that the top growth of leafy spurge responded rather readily to treatments with all the chemicals mentioned. Esters, however, were by far the most effective in destroying the top growth and, with repeated applications, in reducing stand by 65 or more per cent., which should be regarded as economically significant control. The same reduction was only occasionally produced by amine salts at rates not less than 2-3 lbs./a. and never by the sodium salt.

In general, rates above 3 lbs./a. were progressively more effective. In one case a pulverized acid of 2,4-D was used as dust from 10 to 30 lbs./a. and produced kill of 37, 67 and 83 per cent. respectively. In no case a 100 per cent. kill was obtained, irrespective of the rates and kinds of the chemicals used, unless the chemical treatments were followed with various cultivations and several retreatments.

2,4,5-T treatments. This chemical, if used alone, showed no advantage and often was less effective on leafy spurge than 2,4-D alone, particularly where the latter was applied in an ester form.

Mixtures of 2,4-D and 2,4,5-T. In several reports the mixtures of the two chemicals were used. (University of Saskatchewan, University of Minnesota, Bureau of Plant Industry, Minnesota). Wherever the separately manufactured formulations of 2,4-D and 2,4,5-T were locally combined for the treatments, no advantage was observed at comparable rates from the addition of 2,4,5-T. In some instances a commercial formulation of 2,4-D and 2,4,5-T was used and "promising results" or a complete kill was obtained. This possibility deserves a serious consideration in future years.

Amate. In two reports amate was used alone and in combination with 2,4-D. The rates of less than 480 lbs./a. of amate alone were relatively ineffective. At the same time, even lower rates were injurious to grasses. In combination with 2,4-D at 1, 2 and 3 lbs./a. rates the reciprocal activation between the two chemicals seems to occur. In some instances such combinations gave up to 95 or even 100 per cent. control through the growing season of 1949. The rates in this case were 480 lbs./a. of amate and 2 lbs./a. of 2,4-D.

Borascu. Borascu was applied at 15, 22 and 27 lbs./a. In all the plots the weed was eliminated to the extent of from 80 to 100 per cent.

Razorite. Razorite at 9, 11, 14, 16 and 20 lbs./a. produced from 86 to 99 per cent. top kill with only 5 to 10 per cent. surviving in October.

Polybor. Polybor at 5.5 to 16 lbs./a. showed varying results with the top kill ranging from 55 to 97 per cent. and the surviving plants in October between 5 and 40 per cent.

Polybor-chlorate. Polybor-chlorate at 5.5, 8, 11, 14 and 16 lbs./a. rates produced from 86 to 98 per cent. of top kill and 60 to 20 per cent. surviving plants in the late fall.

All boron compounds were hard on grass.

On the whole, the results indicate reasonably good possibilities for an economically significant control of leafy spurge, both by the systemic and contact chemicals used. The prospects of complete elimination are still not clear. From all the experiments reported, one important deduction may be drawn and this is that the rates of 2,4-D or 2,4-D and 2,4,5-T combinations previously recommended for this weed were too low.

As to the best time of application, a very clear controversy exists. In some cases the best kill was observed in treatments made at an early rosette stage, while in others fall treatments seemed to give a better kill. Before this important problem is more definitely settled by further work, the treatments at the early bud stage still appear to give more dependable results.

A combination of chemical and cultural treatments such as cultivations prior to or following the treatment and reseeding to grasses of the treated areas seems to have a good promise. Unfortunately, only few results were available from the 1949 work, in spite of this point being stressed in the 1948 summary report on leafy spurge.

PROJECT I. Use of Herbicides In Control of Perennial Herbaceous Weeds.

Abstracts of Results of Co-operators

Leafy Spurge

Response of leafy spurge (Euphorbia esula) to herbicides. Coupland, R.TT. Unreplicated plots of leafy spurge 10 by 7 feet in size were treated on silty clay loam in the dark-brown soil zone at Saskatoon during the dry summer of 1948 with ethyl ester of 2,4-D and with 50 and 75 per cent. mixtures of this with 2,4,5-T at 1, 1.5 and 3 pounds of acid per acre in 5 gallons of water. Solid infestations of the weed, averaging 226 shoots per square yard, were treated on June 29th when in flower. The temperature was 78° F., the sky was clear and an 18 m.p.h. wind was blowing. Recounts made one month after treatment showed variations from 58 to 96 per cent. reduction in stand, with an average of 85 per cent. No apparent advantage of one chemical mixture over the others or of the highest rate over the lower ones was observed. During August and September regrowth occurred which was retreated in late September using the same chemicals at the same rates. This treatment was ineffective as shown by the vigorous growth of the plants on treated areas during 1949, which could not be distinguished from untreated plots. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada).
Officially approved for public use.

Reaction of weed perennials to Weedone Brush Killer 32. Hoggeness, H.G. and Larson, A.H. One-half square rod plots of Canada thistle were sprayed in early summer with Weedone Brush Killer 32 diluted 1 to 50 with water. The amount of herbicide solution applied varied as follows: (1) Light coverage -- plants sprayed lightly once; (2) Moderate coverage -- plants sprayed lightly twice; (3) Full coverage -- care taken to wet all aerial parts of the plant. Results: Light and moderate applications caused distortions of the stem but did not kill the plants. Stem distortions also developed on thistles receiving full coverage but in this case the damage from the herbicide was permanent as the plants were dead after about four weeks. Natural infestations of wild rose, milkweed and leafy spurge were also sprayed with Brush Killer 32. Care was taken to thoroughly wet these plants. In each instance the weeds were killed. The data indicates that the degree of coverage with an herbicide is an important factor in the mortality of certain perennial weeds. (Contribution of Plant Physiology Department, University Experimental Station, University of Minnesota, St. Paul, Minn.)
Officially approved for public use.

Some observations on leafy spurge (Euphorbia esula) control by chemical herbicides. Horner, W.H. Late in June, 1948 leafy spurge was treated with two pounds acid equivalent in ester form. of 2,4-D; reseeded with crested wheat grass and treated with the same ester in 1949 at about 1¼ pounds. In October, 1949, the infestation was markedly reduced in size and stand. Another sizeable infestation of leafy spurge (approximately 20 acres) was treated in July 1947 with 1½ pound rates of an amine of 2,4-D, 2 pound rates as ester were applied late in June and again in September of 1948 then four treatments at 8 ounce rates each in the summer of 1949 spaced about four weeks apart. In October of 1949 the infestation is reduced about 95% but by all observations the remaining 5% is highly resistant to 2,4-D and not much progress has been made with the 1949 treatments.
(Contribution of the Provincial Dept. of Agriculture, Regina, Sask.).
Officially approved for public use.

The effect of treating leafy spurge (Euphorbia esula) with various boron compound at several rates of application in Kingsbury County. Kratochvil, D.E., Lyle A. Derscheid, and L. M. Stahler. Randomized 10 by 10 foot plots of leafy spurge (Euphorbia esula) were treated in duplicate with 16.34, 21.78 or 27.23 pounds per square rod of Borascu; 8.17, 10.89, 13.61 or 16.34 pounds of anhydrous razorite; 8.17, 10.89, 13.61, 16.34, or 5.45 pounds of Polybor; and 8.17, 10.89, or 13.61 pounds of Polybor-chlorate. Treatment was made June 2, 1949 when the leafy spurge was starting to bloom. Counts were made August 26, 1949. Per cent elimination was figured by comparing treated plots to untreated. At the time of counting, regrowth on the plots was stunted. All formulations gave an 80 per cent. or better elimination except the Polybor at the 5.45 pound rate. The Borascu eliminated 94.21 to 98.84 per cent. of the spurge; the anhydrous razorite 86.10 to 98.46 per cent. In the plots treated with these two formulations there was an excellent growth of Kentucky Blue Grass (Poa pratensis.). Polybor eliminated 54.83 per cent. at the 5.45 pound rate; up to 96.91 per cent at the 13.61 and 16.34 pound rates. At the lower three rates of Polybor there was a fair stand of grass remaining. The highest two rates of Polybor and all rates of Polybor-chlorate eliminated a high per cent. of the grass. Polybor-chlorate varied in per cent. elimination of leafy spurge from 86.49 to 98.07 per cent. Results indicate all formulations of boron compounds to be about equal in eliminating spurge; however the rates required may vary. (Contributed by the Agronomy Department of the South Dakota Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)
Officially approved for public use.

Effect of cultivation and spraying on Leafy Spurge (Euphorbia Esula). Leggett, H.W. A 25 acre field infested with leafy spurge was plowed and worked down in the summer of 1948. In the spring of 1949 the field was double disked and cultivated and then given a pre-emergence spraying using 1 pound 2,4-D acid per acre of the ester type. In June the field was cultivated and when topgrowth had 4 to 6 true leaves it was divided in half and part dusted with 1 pound of a sodium salt dust and the other with an ester dust of 2,4-D. The field was cultivated in July twice and in August. When the spurge was again showing, part of the field was sprayed with 5 ozs. acid per acre of ester in water and part with 5 ozs. acid in diesel fuel. The field was cultivated once in September and in October. A few plots were laid down using 6 pounds acid per acre of Brush Killer 32. All of the treatments outlined above with the exception of the last gave 100% kill of the topgrowth. Each succeeding crop of leafy spurge appeared weak but no visible reduction in the stand was observed. The last treatment has not had any chance as yet to determine anything. (Contribution of Dominion Experimental Station, Lacombe, Alberta, Canada).
Officially approved for public use.

Response of Leafy Spurge to herbicides. Miller, John H. and H.G.Heggeness. In 1949 square rod plots of leafy spurge were treated in triplicate with 1, 2 and 3 pounds of 2,4,5-T or 2,4,-D and at the rate of 28.6 gallons of solution per acre. Applications were made in early spring, bud, and full bloom stages. Quadrats were established and counts were made in each plot to determine per cent. survival. The following treatments were used; ester of 2,4-D, amine salt of 2,4-D, ester of 2,4,5-T, alkalized solutions of the above, acidified solutions of the above, ester of 2,4-D in oil, ester of 2,4,5-T in oil, and amine salt of 2,4-D in one part oil and one part water. In no case was eradication of the leafy spurge realized by these treatments, though it is possible that some spurge plants may have developed from viable seeds in the soil or from lateral invasion. Results, based on early spring and fall counts, indicate that the 2,4-D ester in oil applied at a 2 pound

dosage in the early spring stage gave most promising control (less than 25% survival). Using 65% decrease in stand as standard of control, the 2,4,5-T formulations and ester of 2,4-D formulations in water appear to have some promise. Amine salt of 2,4-D treatments were not satisfactory. The early spring treatment was outstanding as compared to bud or full bloom stages. Dosages of 2 and 3 pounds of acid per acre appear considerably better than 1 pound per acre. (Contribution of U.S.D.A. Bureau of Plant Industry and Minnesota Agricultural Experiment Station University Farm, St. Paul, Minnesota).
Officially approved for public use.

Using 2,4-D as soil sterilant on deep rooted perennial weeds. Shafer, Neal E. Much of the acreage of leafy spurge (Euphorbia esula) (L.) Hill and Russian knapweed (Centaurea picris) Pall. in Nebraska is confined to small patches of one acre or less. Because these patches threaten otherwise non-infested land, high expenditures per acre for control and eradication measures are warranted. In the past sodium chlorate, Atlacide and Borascu have been recommended. These materials are costly because of initial cost and also because of crops lost due to subsequent soil sterility following treatment. High rates of 2,4-D were used, yet cost per acre was approximately half that of the above mentioned materials. Dry 2,4-D acid at rates of 10 pounds, 20 pounds and 30 pounds per acre were applied to plots of leafy spurge infesting a native grass pasture and to Russian knapweed infesting a bromegrass pasture. Application was made November 11, 1948. The acid can be mixed with 3 or 4 pounds of fine sand, soil or talcum to facilitate more uniform spreading. Notes taken in October, 1949 showed the following percentage kills of leafy spurge (average of three replications): 37, 58, and 83 for the 10, 20 and 30 pound rates respectively. No reduction in stand of the native grass species was observed. Russian knapweed showed the following percentage kills also in October, 1949: 47, 67 and 82 for the 10, 20 and 30 pound rates, respectively. Some onion leaf was observed on the bromegrass early in the season, but no reduction in stand occurred. The use of an ester dust of 2,4-D was approximately one-half as effective as 100 per cent. 2,4-D acid. Fall application was more effective than spring application. (Contribution of Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska).
No approval is required.

Control of leafy spurge (Euphorbia esula) with 2,4-D and 2,4,5-T. Slife, F.W. and R.F. Fuelleman. Leafy spurge plots were treated on two dates in 1948, and also in 1949. Rates used were ½, 2 and 4 pounds of 2,4-D acid in the amine and ester forms and similar rates with the ester form of 2,4,5-T. Replicated square rod plots were located in two different areas. In one area no attempt has been made to control the spurge in previous years; in the other area, good cultural practices had been followed which reduced the vigor of the spurge. In each area the plots were treated on May 12 and July 10 in 1948, and on May 7 and July 20 in 1949. Stand counts taken on September 17, 1949 indicated that the spurge population was greatly reduced by the four treatments, but that it has not been eliminated. The exception to this was the use of four pounds of acid in conjunction with good cultural practices. 2,4,5-T has not been any more effective on leafy spurge than 2,4-D. Applications of 2,4-D to new plots in September of 1948 were not effective in reducing the stand. Examination of the root systems from all plots indicated that the chemicals have not been translocated more than a few inches below ground level. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.
Officially approved for public use.

Control of leafy spurge (Euphorbia esula) with ammate and 2,4-D. Slife, F.W. and R.F. Fuelleman. Square-rod plots of leafy spurge were treated on May 7, 1949, with ammate, ammate with 2,4-D and 2,4-D ester in oil. Observations on September 17, 1949, indicated 95 per cent. control with 480 pounds of ammate per acre. Four-hundred-eighty pounds of ammate mixed with 2 pounds of 2,4-D acid in the ester form per acre gave 100 per cent. control during the 1949 season. Three-hundred-twenty pounds of ammate or 320 pounds of ammate mixed with 1 pound of 2,4-D per acre gave only 25 per cent. control of spurge. One-hundred-sixty pounds of ammate per acre did not reduce the stand of spurge, but 160 pounds of ammate mixed with 2 pounds of 2,4-D acid per acre gave 95 per cent. control of leafy spurge. The results on the latter plot were comparable to 480 pounds of ammate or 480 pounds of ammate and 2 pounds of 2,4-D acid per acre. Other spurge plots were treated with the ester form of 2,4-D in kerosene. Rates used were 1 and 2 pounds of 2,4-D acid per acre in 10 gallons of oil and 2 pounds of 2,4-D acid per acre in 40 gallons of oil. The spurge recovered as quickly on those plots as those treated with 2,4-D in water and no reduction in stand was accomplished by this treatment. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois). Officially approved for public use.

Effect of several boron formulations as herbicides for control of leafy spurge (Euphorbia esula), Brookings, South Dakota, 1949. Stahler, L. M., D. E. Kratchovil and L. A. Derscheid. Borascu at 15 pounds per square rod, Razorite at 10, 15 and 20 pounds per square rod; Polybor at 10 and 15 pounds per square rod; Polybor-chlorate at 5 and 10 pounds per square rod were applied to replicated plots of leafy spurge in early bloom stage on May 25, 1949. All materials were applied dry with the exception of the Polybor-chlorate, which is a spray solution. Ample precipitation in the last half of May was followed by a dry summer and fall. Plots treated with 15 pounds Borascu--which consistently eliminates 95 to 100% of spurge plants--showed 10% survival on October 1, 1949, while Razorite at 10, 15 and 20 pounds showed 5, 10 and 10% survival respectively. Polybor-chlorate at 5 and 10 pounds showed 60 and 20% survival respectively; Polybor at 10 and 15 pounds showed 40 and 5% survival respectively. Herbicides were furnished by Pacific Coast Borax Company. (Contributed by Bureau of Plant Industry of U.S.D.A. and Agronomy Department of South Dakota State College). Officially approved for Public use.

Response of leafy spurge (Euphorbia esula) and other perennials to combinations of 2,4-D and ammonium sulfamate. Warden, Robert L. Combinations of ammonium sulfamate and 2,4-D have consistently resulted in increased kills on leafy spurge in tests conducted since 1945. The 1948 treatments were applied on duplicate plots on July 30, 1948 to a heavy uniform stand of spurge just past the full bloom stage under fair moisture conditions. The infestation was located in a foothill grassland area. Treatments consisted of the monohydrate sodium salt of 2,4-D at 1, 2 and 3 lbs. acid equivalent in all possible combinations with 33, 66 and 100 lbs. sulfamate per acre as well as 2 and 3 lbs. 2,4-D alone. Treatments were applied in 60 gallons of water per acre. Readings taken June 15, 1949 indicated that the 66 and 100 lb. rates had reduced the vigor of the grass growing with the spurge but the stand was about equal to that on untreated areas. Results show that the kill of spurge increased with the rate of sulfamate used but increased rates of 2,4-D did not increase kills significantly, except possibly when the low rate of sulfamate was used. There were no treatments applied using sulfamate alone but data obtained from straight sulfamate treatments applied in 1947 indicated that at least 75 lbs. per acre would be required to give 50% control. Reduction in stand due to 2,4-D alone was 30 and 24 per cent. respectively from the 2 and 3 lb. rates. Percent control obtained by the use of 33 lbs. of sulfamate and

1, 2 and 3 lbs. of 2,4-D respectively, was 45, 65 and 70. With 66 lbs. of sulfamate and 1, 2 and 3 lbs. 2,4-D, the control was 78, 63 and 65 per cent. and with 100 lbs. sulfamate the control was increased to 88, 65 and 88 per cent. for the three rates of 2,4-D. One years results indicate that kills of Russian Knapweed may be increased by this combination but that kills of Canada thistle, wild morning glory, whitetop and perennial sow thistle were not increased. (Contribution of the Agronomy and Soils Dept., Montana Agricultural Experiment Station).
Officially approved for public use.

Controlling leafy spurge with 2,4-D. Wood, H.E., J. J. Bourns and W. J. Breakey. A heavy infestation of leafy spurge under pasture and in competition with native grasses, including quack grass, on light soil near Winkler, has been under trial treatment for three seasons. Plots, approximately one acre in area, have been machine sprayed when the plants were in full bloom to early seed stage (late June and early July) with ester and amine formulations of 2,4-D varying from ¾ pounds to 4 pounds acid per acre; re-treatment of plots was carried out in 1948 (on a few plots, July 13 and September 28) and 1949, as well as establishing new plots each season. Cattle have pastured on the area throughout. The following observations are offered: (1) The stand of leafy spurge on all treated plots has been markedly reduced with grass taking over; on the plots treated since 1947, the reduction in spurge was estimated to be 80%; for 1948 plots 60%; about 25% re-growth was showing on the 1949 plots sprayed June 29. (2) There appeared to be little difference between formulations or rates; ¾ pounds acid per acre plots sprayed for the first time in 1949 showed no more re-growth than had the 1947 plots treated at 2 and 4 pounds, and checked as to re-growth at the end of that season. (3) Leafy spurge seems to respond most satisfactorily to 2,4-D treatment when the plant is in full flower. (4) While a marked reduction in stand of leafy spurge is obtained, there seems little likelihood that eradication of this weed is possible with 2,4-D. (Contribution by the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada).
Officially approved for public use.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACIOUS WEEDS

Russian Knapweed — Investigation Leader: G. Knowles

It appears that Russian Knapweed is not easily controlled with 2,4-D and a combination of 2,4-D and 2,4,5-T seems to offer no hope. Certain other mixtures mentioned in the abstract from the Soils Research Lab., Swift Current, Sask. look promising.

Use of 2,4-D and 2,4,5-T in the control of Russian Knapweed. Bohmont, Dale W. Randomized, triplicate plots were treated with various combinations of the ester and amine of 2,4-D and the ester of 2,4,5-T at 2 and 3 pound concentrations. Applications were made on June 21 when the plants were in the bud stage of growth and a duplicate plot of each concentration was retreated after regrowth appeared which was Aug. 3. Quadrat counts were taken and the data computed on a per cent survival basis. The 2,4-D treatments in either the ester or the amine formulation gave highly significant control over the combinations of 2,4-D and 2,4,5-T at all concentrations. The single treatment of 3 pounds amine gave 99% control and was almost as effective as the double treatment of 3 pounds amine. The double treatment of 2,4-D was more effective than the single treatment. In all treatments the 3 pound concentrations were more effective than the 2 pound, although the difference was not significant. The per cent kill was greater in the amine of 2,4-D than the ester; however, the difference was not statistically significant. (Contribution of University of Wyoming, Laramie, Wyoming).

RUSSIAN KNAPWEED

Material	Concentration	Treated at Bud Stage			Treated at Bud and Regrowth Stage		
		Original Count	Final Count	% Survival	Original Count	Final Count	% Survival
Ester 2,4-D	2 lb.	62	56	90.3	51	7	13.7
Ester 2,4-D	3 lb.	43	30	69.8	51	3	5.9
Amine 2,4-D	2 lb.	58	10	20.0	68	4	5.9
Amine 2,4-D	3 lb.	53	2	.04	50	1	.02
Ester 2,4-D 1#) Ester 24,5-T 1#)	2 lb.	39	53	135.9	77	74	96.1
Amine 2,4-D 1#) Ester 24,5-T 1#)	2 lb.	39	56	143.6	51	75	147.1
Check		53	71	133.9	53	71	134.0
Standard error of the mean difference - 30.1							

Response of Russian Knapweed (Centaurea picris) to herbicides. Coupland, R.T. Unreplicated plots of Russian Knapweed 10 by 7 feet in size were treated on silty clay loam in the dark-brown soil zone at Saskatoon during the dry summer of 1948 with ethyl ester of 2,4-D and with 50 and 75 per cent mixtures of this with 2,4,5-T at 1, 1.5 and 3 pounds of acid per acre in 5 gallons of water. Solid infestations of the weed, averaging 28 shoots per square yard, were treated on June 29 when in flower. The temperature was 78°F., the sky was clear and an 18 m.p.h. wind was blowing. Recounts made one month after treatment showed reduction in stand varying from 7 to 25 per cent and averaging 15 per cent. Two months after treatment the variation was from 14 per cent increase to 43 per cent decrease in stand and averaged 10 per cent reduction. No apparent advantage of one chemical mixture over another or of the highest rate over the lower ones was observed. Subsequent regrowth was treated in late September using the same chemical at the same rates. The ineffectiveness of the treatments in controlling the weed was shown by the vigorous, dense growth occurring during 1949, which could not be distinguished from that in control areas. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Response of Russian Knapweed to Herbicides. Bisal, F. Russian Knapweed was treated with the ester of 2,4-D (Weed-no-more) and with the ester of 2,4-D mixed with H_2SO_4, Na_2CO_3 and HCl.

The mixtures were as follows:

1) 2 lbs. of the 2,4-D acid equivalent (ester) plus 12 litres of 6N of H_2SO_4/acre.

2) 2 lbs. of the 2,4-D acid equivalent (ester) plus 12 litres of 6N HCl/acre.

3) 2 lbs. of the 2,4-D acid equivalent (ester) plus 1½ lbs. of Na_2CO_3/acre.

Knapweed treated on June 22, 1949 and on October 10, 1949 results were as follows:

2 lbs. of 2,4-D acid equivalent/acre (ester gave a kill of all top growth.
Mixture No. 1 used at the rate of 2 lbs. of acid equivalent of 2,4-D/acre gave complete kill of top growth.
Mixture No. 2 at same rate of 2 lbs./acre acid equivalent gave complete kill of top growth.
Mixture No. 3 at the rate of 2 lbs. acid equivalent/acre gave complete kill of top growth. The buds on the roots down to at least 8 inches have been killed. However the results cannot be accurately determined until the spring of 1950.

Plots which had been treated in 1948 with ester of 2,4-D at the rate of 2 lbs. acid equivalent/acre gave a reduction of approximately 90% in stand as determined on June 22, 1949. Contributed by Swift Current Soils Research Lab., Swift Current, Sask.

PROJECT I USE OF HERBICIDES IN CONTROL OF PERENNIAL HERBACIOUS WEEDS

Other Herbacious Perennials — Investigation Leader: G. Knowles

The reaction of a list of other perennial weeds to 2,4-D and 2,4,5-T is shown in the accompanying tables. For easy reference these weeds are arranged alphabetically. They are classified, according to their reaction to 2,4-D and 2,4,5-T, as very sensitive, sensitive, semi-resistant, resistant.

Basis of Classification:

I. (Very Sensitive) Any perennial plant that is controlled at its most susceptible stage of growth by one application of ½ pound or less 2,4-D acid per acre.

II. (Sensitive) - Any perennial plant that is controlled at its most susceptible stage of growth by one application of from ½ to 1 pound, 2,4-D acid per acre.

III. (Semi-resistant) - Any perennial plant that is controlled at its most susceptible stage of growth by more than one application of up to 2 pounds, 2,4-D acid per acre.

IV. (Resistant) - Any perennial plant that is not controlled at any stage of growth by repeated applications of up to 2 pounds of 2,4-D acid per acre.

USE OF ROMAN NUMERALS:-

For the sake of brevity the above four Roman numerals are used in the accompanying tables to indicate the reaction of each perennial weed at the growth stage when the treatment was applied. e.g. (I) very sensitive (II) sensitive (III) semi-resistant (IV) Resistant.

ABBREVIATIONS:- A - amine; E - ester, S - sodium and T - 2,4,5-T.

CLASSIFICATION

When experimenters reported different amounts of 2,4-D required to control the same weed the range of difference is indicated but the classification is based on the lowest amount used.

Common Name	Scientific Name	Formulation and amount applied per acre	Location, State or Province	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	Classification
Artichoke, Jerusalem	Helianthus Tuberosus	1 lb.		11	11			11
Aster	Aster spp.	1½ lbs. A.E.S.T.		111	111	111		111
Bindweed, hedge	Convolvulus sepium	½ lb. A.E.S.		1				
		1½ lb. E.		111		111		1
		½ lb. A.	Illinois	1	1			
	Convolvulus sepium	½-¾ lb. E. or A.	S.D.	11	111	111	111	
Bindweed, field	Convolvulus anvensis	½ lb. E.	Nebraska	1	1	1	1	
		¾ lb. A.E.S.T.		11	11	11		1
		1 lb. A.T.	Kansas		11	11	11	
Buckhorn	Plantago lanceolata	½ lb. A.E.S.		1				1
Burdock	Anctium minus	½ lb. A.		1				
		1 lb. E.		11				1
Buckwheat, flase	Polygonum scandens	1 lb. E.	Kansas	111	111			111
Carrot, wild	Daucus carota	1 lb.		11				11
" "	" "	½ lb. E. or A.	S.D.	11	11	111	11	11
Catnip	Nepeta Catania	½ lb.		1				1
Chicory	Cichorium Intybus	½ lb.		1				1
Cinquefoil	Potentilla sp.	½ lb.		1				1
Creeping Charley	Glecoma hederacea	½ lb.		1				1
Cactus, prickly pear	Opuntia sp.	1½ lbs. A.E.S.T.		1V				1V

Common Name	Scientific Name	Formulation and amount applied per acre	Location, State or Province	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	Classification
Cockle, white	Lychnis alba	1½ lb. A.E.S.T.		IV				IV
Cockle, corn	Agnostemma githago	2 1/3 lbs. E.	Illinois	III	IV	IV		III
Clover, sweet	Melilotus sp.	¾ lb. E.		I				I
Chickweed, field	Cerastium arvense	1 lb.		II		II		II
Chickweed, mouse ear	Cerastium vulgatum	¼ - ½ lb. E. or A.	S.D.	III	IV	IV	IV	III
Cherry ground	Physalis subglalrata	1 lb. A.E.	Illinois	IV	IV	IV		IV
Dandelion, fall	Leontodon autumnalis	1½ lb. S.A. ½ lb.		III I				 I
Dandelion	Taraxacum officinale	1 lb.		II				II
Dock, curled	Rumex crispus	1½ lbs. A.E.S.		III				III
Dogbane	Apocynum cannabium	1 lb. A.--½ lb. E.		II				II
Fleabane	Erigeron spp.	½ lb.		I				I
Goatsbeard	Tragopogon sp.	½ lb. 2 lbs. S.A.		I III				I
Goldenrod	Solidago spp.	1 lb. 2 lbs. S.A.		II III				II
Garlic wild	Allium vineale	2 1/3 lbs. E. 1 lb. E.	Illinois "	III II	IV	IV	II II	II
Gum weed	Grindelia squarrosa	¾ lb. E.		II				II

Common Name	Scientific Name	Formulation and amount applied per acre	Location, State or Province	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	Classification
Heal all	Prunella vulgaris	1/2 lb.		1				1
Hoary vervain	Verbana stricta	1 lb.		11				11
Horse nettle	Solanum canolinense	1½ lb. A.E.		111				111
Horse tail	Equisetum arvense	1/2 lb.-¾ lb. E. 1¼ lb. A.E.S.	Manitoba	11 111				11
Hoary cress	Lepidium Draba	1/2 lb.-3 lbs.A.E. 1 lb. A.E.	Sask.	1V	1V	1V	1V	11
Iron weed	Veronia baldwinii	1 lb. E.	Kansas	111	111			111
Knapweed Russian	Centaurea picris	2 lbs. A.E.T. 3 lbs. E.E+T.	Nebr. Sask.	111	 1V			111
Lettuce, blue " "	Lactuca pulchella " "	1/2 lb. A.E.S. 1 lb. ½-¾ lb. E. or A.	S.D.	1 11 11	11	111		1
Licorice, wild	Glycorrhiza lepidota	1/2 lb.		1				1
Milk weed, common " " "	Aselepias syniaca	2½ lbs. A.E.S.		1V				1V
	" venticillata	1 lb.		11				11
	Gonolobus laevis	1 lb. E.	Kansas	1V				1V
	" "	1 lb. T.	"	1V				1V
	" gonocarpos	2 lbs. E.	Illinois	1V	1V	1V		1V
Moon seed	Menispermum Canadense	½ lb.		1				1

Common Name	Scientific Name	Formulation and amount applied per acre	Location State or Province	Active growth pre-bud	First flowering bud	Full bloom	Fall growth	Classification
Mullein, common	Verbascum Thapsus	1 lb.		11				11
Nettle, stinging	Urtica dioica	½ lb.		1				1
Nettle, horse	Solanum carolinense	½-1 lb. E. or A.	S.D.	1V	1V	1V	1V	1V
Ox-eye-daisy	Chrysanthemum Leucanthemum	1½ lbs. S.A.		111		111		111
Onion, wild	Allium sp.	2 lbs. E.		111				111
Orange hawkweed	Hienacium aurantiacum	2 lbs. S.A.		111		111		111
Plantain, common	Plantago Major	½ lb. A.E.S. ¾ lb. E.		1 11		11		1
Potatoes, wild sweet	Ipomea pandurata	1 lb. A.	Illinois	111	111	111		111
Primrose evening " "	Oenothera sp. Oenothera biennis	½ lb. ½-¾ lb. E. or A.	S.D.	1 11	11	111	11	1
Poverty weed	Iva axillaris	1 lb.		11				11
Parsnip, wild	Pastinaca sativa	1 lb.		11				11
Rosin Weed	Silphium sp.	1 lb.		11				11
Ragweed, bur	Franseria tomentosa	¾ lb. A.T. 1½ lbs. E.		11 11				11
" "	" discolor	2 lbs. E.T.	Nebr.		111			111
" false	Iva ciliata	½ lb.		1				1
" perennial	Ambrosia psilostachya	½-¾ lb. E. or A.	S.D.	11	11	111	11	11

Common Name	Scientific Name	Formulation and amount applied per acre	Location State or Province	Active growth pre-bud	First Flowering bud	Full bloom	Fall growth	Classification
Rose, wild	Rosa sp.	2 lbs. T.	Sask.	111				
		1 lb. T.		11				11
		¾ lb. T.	Man.	11	11			
		2½ lbs. A.E.S.		1V				
		¾ T.	Man.	11	11			
Sage, sand	Artemesia gnaphaloides	1 lb. E.	Nebr.		11			11
" pasture	" frigida	3 lbs.	Sask.		111			111
Sorrel, red ox	Oxalis acetosella	2½ lbs. A.E.S.		1V				1V
" wood	"	2½ lbs. A.E.S.		1V				
		2 lbs. E.	Illinois	1V	1V			
" sheep	Rumex acetosalla	1 lb.		11				11
		1½ lbs. S.A.		111			111	
		1 lb. A.E.	Illinois	1V	1V			
Strawberry wild	Fragaria Americana	1 lb. T.		11				11
		4 lbs. E.						
Spurge leafy	Euphorbia Esula	1 lb. A.E.T.	Nebr.			11		
" "	" "	1 lb. E.	Man.	111	111	111		
" "	" "	½-1lb.E.orA.orT.	S.D.	111	111	111	111	111
Sunflower perennial	Helianthus sp.	½ lb.		1				1
Sunflower Perennial	H. maximiliani + grosseserratus	½-½ lb. E. or A.	S.D.	11	11	111		11
Snowberry Western	Symphorocarpus occidentalis	½ to 2 lbs. A.E.T.	Sask.	111	111			111
Skeleton weed	Lygodesmia juncea	2½ lbs. A.E.S.		1V				1V

Common Name	Scientific Name	Formulation and amount applied per acre	Location State or Province	Active growth pre-bud	First flowering bud	Full bloom	Fall growth	Classification
Silverberry	Eleganus comutata	½-2 lbs. A.E.T.	Sask.	111	111			111
Toad flax	Linaria vulgaris	3 lbs. A.E. 4 lbs. E.	Sask. Sask.	1V 1V				1V
Thistle, Canadian	Cirsium arvensis	¾ lb. A.E.S.T. 1 lb. E. 3 lbs. A.E.	 Man. Sask.	111 111	111 111 111	111 111		 111
Thistle per. sow	Sonchus arvensis	¾ lb. A.E.S. 1½ lbs. E. ½-3 lbs. A.E. 1 lb. E. ½-¾ lb. E. or A.	 Sask. Man. S.D.	11 111 111 11	 111 11 11	 111 1V	 111	11
Thistle, bull	Cirsium lanceolatum	1 lb. ½-¾ lb. E. or A.	 S.D.	11 11	 11	 111	 111	11
Thistle, Canadian	Cirsium arvense	½-¾ lb. E. or A.	S.D.	111	111	1V	111	111
Tan weed	Pensicaria Muhlenbergia	2 lbs. A. 1 lb. E. 1 lb. T.	Nebr.			111 111 111		111
Vervains	Verbena sp. " stricta	1 lb. 1½ lbs. E.		11 111				11
Vetch, wild	Vicia Cracca	1 lb. S.		11		11		11
Yarrow	Achillea Millifolium	1 lb. 1½ lbs. A.E.S.		11 111		 111		11

Project 1. Use of Herbicides in Control of Perennial Herbaceous Weeds.

Perennial Grasses

B. H. Grigsby

Summary

A number of abstracts dealing with chemicals for the control of perennial grasses were submitted and several members of the research committee suggested that they should be grouped and reported as a part of Project I.

Results obtained on Johnson grass were reported in three abstracts, all dealing with time and rates of application of TCA. These reports are in general agreement that:

(1) Applications of less than 100 lbs. per acre give poor control.
(2) Clipping or cultivation prior to spraying reduces the percentage kill which can be expected.
(3) Better results are obtained when TCA is applied to Johnson grass 18-24 inches tall in July or August.
(4) Repeat applications to control new seedlings are needed.

Treatments of Bermuda grass were reported by Elder, who indicates that TCA at 100 lbs. per acre will control this plant and that applicatinns may be made from June to October. Elder also reports that methyl bromide at ½ lb. per 100 sq. ft. is effective on Bermuda grass. The presence of heavy vegetation on treated areas, however, reduces the effectiveness of the treatment.

Quack grass experiments are reported in 23 abstracts by 15 investigators using TCA, 5 using Chlorosol-A, 1 using thiocyanates and 3 using combinations of various kinds. The only materials reported to give an appreciable reduction of stand of quack grass were TCA and thiosyanates.

No clear cut picture of a minimum rate of application which will give reasonable control is apparent from the data reported. In general, however, less than 50 lbs. per acre have been unsatisfactory. When combinations of TCA and tillage or clipping are used smaller amounts of TCA may be feasible. These data indicate that where TCA alone is used an application of 80 to 100 lbs. per acre may be expected to give an 80 to 90% reduction of quack grass and that for 100% reduction an application of 125 or more pounds of TCA will be required.

Some evidence concerning the effects of soil type and rainfall upon the degree of control is presented in several of the abstracts. A great deal more research on these points is necessary before any generalizations can be made.

Abstracts of Results of Cooperators

Quack grass

Factors Effecting Field Results with Sodium TCA. K.C. Barrons and A.J. Watson. Summarizing two years work in Michigan on quack and blue grass involving more than 1,000 plots treated with Sodium TCA at frequent intervals from April to November, soil moisture appears to be the most important external factor. Best results were obtained on moderately dry soil with scant to moderate rainfall in the month following treatment with Sodium TCA. Inferior results were obtained when applications were made to moist soil and followed by heavy rain. Although some applications made in spring and fall resulted in a high degree of control, summer treatments proved more consistent.

Field observations and limited controlled experiments indicate that best kills may be obtained with TCA on grass low in carbohydrate reserves. Treated grass exhibiting typical low-nitrogen, high-carbohydrate symptoms apears more likely to show a high degree of bud dormancy followed by recovery. The factor of lower carbohydrate reserves may account for the superior results obtained when tillage is combined with TCA treatment. (Contribution from the Dow Chemical Company.)

Increasing the effectiveness of sodium TCA by combining with tillage. Barrons, K.C. and Watson, A.J. Applications of TCA to quack and blue grass combined with various types of tillage has resulted in a greater kill than from TCA alone. Comparisons with tillage alone show the effect of combination treatments to be far greater than additive. The following gave promising results: (1) plowing two weeks after TCA application, (2) shallow plowing followed immediately by spraying of the upturned sod and (3) disking after spray application. Spraying followed immediately by plowing has consistently proved inferior to the above three methods. The best kill from low rates of TCA was obtained when sod was thoroughly disked in late spring, allowed to regrow for 6 weeks, sprayed with Sodium TCA, and then immediately disked again.

Further work is needed on types of tillage and timing. However, these results indicate that combination treatments may make it possible to use relatively low rates of TCA for effective reduction of grass populations in preparation for a subsequent crop. (Contribution from the Dow Chemical Company.)

Eradication of quack or twitch grass (Agropyron repens) with sodium trichloroacetate (TCA 60%). Brenkey, W.J. A series of plots infested with quack grass (Agropyron repens) located in a pasture field, on a light sandy loam soil, were treated with varying amounts of Sodium TCA. The sprayer used was a hand-operated air pressure boom sprayer. A standard knapsack sprayer tank was used as the source of air pressure. A 4-quart container was used for the solution. A constant pressure was maintained at 35 pounds when spraying. Six rates of application were used, namely, 25, 50, 75, 100, 125, and 150 pounds of acid per acre. The grass when sprayed in early June was 10 inches high. All rates of application proved effective in retarding growth but only partial control was gained with the lower rates of 25 and 50 pounds of acid per acre. 75 looks promising. Rates of 100, 125 and 150 pounds proved highly effective and killed all quack grass growth. No new growth was observed in late summer or fall on the plots where the three high rates of application were used. Other growth such as brome grass while killed back, later recovered and showed almost complete survival. (Contribution from the Dominion Experimental Station, Nordon, Manitoba.)

The response of quack grass to applications of TCA and ammonium thiocyanate when combined with cultivation. Buchholtz, K.P. Square rod plots of an undisturbed quack grass sod were treated with the sodium salt of TCA at rates of 25 and 50 lbs. per acre and with 50 and 100 lbs. per acre of ammonium thiocyanate. One series of plots was left untreated. Portions of the five previous treatments were subjected to no cultivation, one thorough disking and one plowing. The herbicides were applied to the plots in water on April 20. The cultural treatments were made on May 17. Initial infestations were estimated at the time the herbicides were applied. Estimates of the recovery of the quack grass were obtained in October. Three replicates were used and the data were analyzed statistically. Untreated and uncultivated plots of quack grass maintained stands of 100 percent during the season. Disked plots had a 100 percent stand and those plowed had a 90 percent stand in October. Uncultivated plots of quack grass treated with TCA averaged 63 percent of original stand, a highly significant reduction. Stands of plots treated with thiocyanate averaged 103 percent of the original stand in October. Disking or plowing greatly increased the effectiveness of TCA. Plots so treated averaged 18 and 12 percent of original stand respectively. Plots treated with thiocyanate averaged 64 percent of original stand for the disking treatment and 27 percent for the plowing treatment. Differences in stand on plots treated with the different rates of TCA and thiocyanate were usually not significant. Rates lower than those specified might be expected to produce satisfactory results when combined with cultivation. (Contribution from the Department of Agronomy, University of Wisconsin, Madison, Wisconsin.)

Response of couch grass (Agropyron repens) to sodium trichloroacetate. Coupland, R.T. A well established stand of couch grass was treated with sodium trichloroacetate at 25, 50, 100 and 150 pounds of active ingredient per acre in 10, 20, 40 and 60 gallons of water, respectively, on July 11, 1949, while the weed was in the vegetative stage. The leaves of the grass were killed within one week at the two heavier rates but were never completely dried up at the lower rates. Regrowth occurred with all treatments but was slowest with the heaviest treatment, where new shoots did not appear until late September. (Contribution from the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Trichloroacetic acid, sodium salt, applied for the control of quack grass (Agropyron repens) growing in black raspberries. Davidson, J.H. Sprays containing TCA sodium salt were applied at the rates of 20, 40 and 80 pounds TCA equivalent in 300 gallons of water per acre. Applications were made October 21, 1948. The soil was a light sand with a heavy quack grass sod around the raspberry plants. Rainfall during the fall, winter and early spring was below normal. In the spring of 1949 emerging leaves on the old fruiting canes were small, deformed and chlorotic. These canes died later in the spring. New shoots from the crown appeared normal until mid-summer when they showed definite chlorosis which became progressively worse as the season advanced. This injury was apparent with 20 lb. and severe with 80 lb. Quack grass control was poor with the 20 lb. and good with 80 lb. (Contribution from the Dow Chemical Company, South Haven, Michigan.)

Effect of TCA on perennial grasses. Frieson H.A. Sodium TCA was sprayed at rates of viz: 20, 40, 80, 100 and 160 pounds per acre on established patches of quack grass Agropyron repens just prior to heading of the grass. The top growth was effectively killed by all rates. Root kills were incomplete, eight weeks after treatment all plots showed 5 to 15 percent recovery. All plots, except the one treated at 80 pounds per acre, were one-way disked at a depth of five inches in late August, two months after treatment. Much of the disked up root material appeared to be still in a viable condition. The untilled plot was retreated at 80 pounds per acre in late July. Subsequent regrowth was not observed on this plot. All rates of TCA had a severe

stunting effect on the Russian thistle Salsola Kali and red root pigweed Amaranthus retroflexus growing around the plot margin.

The 80 pounds per acre of TCA resulted in a killing of the top growth of crested wheat Agropyron cristatum with no sign of recovery in 1949. (Contribution from the Dominion Experimental Station, Scott, Sask.)

The use of sodium TCA for the control of quack grass in uncultivated areas. Grigsby, B.H. Heavy sod of quack grass in light sandy soil was sprayed with sodium TCA at East Lansing and Lake City. The grass in each case was in the early flowering stage. TCA, 30 lbs/A, gave control for a 60 day period but an estimated regrowth of 40% was apparent in 90 days. Much of this new growth, however, appeared to be new seedlings and only occasional tufts from old rhizomes were found.

TCA at 50 lbs/A was applied to an area where a lawn was to be established. In this case 20 gallons/A of Stoddard Solvent were added and the mixture applied as an emulsion. A complete kill of quack grass was obtained and lawn grass seed was sown in September. No injurious effects of TCA on the grass seedling were observed and the area now is a satisfactory lawn. (Contribution from the Michigan Agricultural Experiment Station.)

Studies on the herbicidal action of TCA sodium salt. Helgeson, E.A., Richard Konzak and Robert Thacker. Quack grass plots treated with TCA at rates from 25 to 100 lbs per acre acid equivalent in 1948 showed complete regrowth in 1949. Additional quack grass plots sprayed at rates from 50 to 150 lbs/A with acid (sodium salt) the past summer showed complete top kill by fall at 100 lbs or more. In all cases live and apparently healthy rhizomes were present on October 29. Owing to the dry summer season the chemical may not have penetrated deeply enough to kill under ground parts. (Contribution from the North Dakota Agricultural College.)

Some observations on the herbicidal effects of Chlorosol A. Helgeson, E.A. and Robert Thacker. During the past summer quack grass and bromegrass were sprayed with aqueous solutions of Chlorosol A at rates varying from 50 to 150 lbs. per acre active ingredient. Top kill increased progressively with increasing concentrations with no regrowth evident at rates above 75 lbs. Germination tests with wheat barley, corn, soybeans and field peas planted in soils treated at concentrations from 2 to 250 ppm. showed no consistent retarding effect up to 15 ppm. At 15 ppm. and up a gradual decrease in germination and seedling development occurred. Tops of well developed plants of small ragweed, wild lettuce, curled dock and Canada thistle were completely killed when sprayed with a solution of 1 lb. per gallon water. Leaves, but not stems, of golden rod, annual and perennial sowthistle, pigweed and kochia were killed by above spray. Dogbane, hinghead, marsh elder, and stinging nettle showed little effect 16 days after spraying. (Contribution from the North Dakota Agricultural College.)

The effect of treating quack grass (Agropyron repens) with several herbicides. Kratochvil, J.E., Kyle L. Derscheid and L.M. Stahler. Sodium trichloroacetate at rates of 50, 75, 100 and 125 pounds acid per acre; isopropyl-phenyl-carbamate at 20 pounds per acre; E.H. No. 1 and E.H. No. 2 (Carbide and Carbon Chemical Corp.) and E.C. 3441 (Sharples Chemicals) at 2, 4 and 8 pounds per acre; Chlorosol-A at 25, 50, 75 and 100 pounds per acre; 7BD (General Chemicals) at 10 and 20 gallons per acre; Polybor-chlorate at 500 and 800 pounds per acre were applied to vigorously growing quack grass in early summer when the grass was heading. All herbicides were applied in 40 gallons water per acre except 7BD which was applied in 40 gallons fuel oil and the Polybor-chlorate in 480 gallons water per acre. Precipitation following

application was limited. Visual estimation of kill on October 10, 1949 showed better than 90% elimination where 125 pounds TCA acid per acre was applied, 74% for 100 pounds, 68% for 75 pounds and 36% where 50 pounds was used. 7BD at 10 gallons per acre gave less than 5% control of quack grass; 20% control at 20 gallons per acre. Three-hundred-twenty pounds per acre of Polybor-chlorate gave less than 5% reduction; 640 pounds 50% elimination. None of the other herbicides showed any herbicidal effect on quack grass four months after application. (Contribution from the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

Response of quack grass (Agropyson repens) to treatments of TCA. Lee, Oliver C. Plots of quack grass were treated with TCA at the rates of 40, 60, 80, 100, 120 and 150 pounds of acid per acre. Sprays were applied on August 3, 1949. Plots were located in a permanent pasture that had been closely grazed during the summer. No green appeared by the middle of October on plots treated with 60 pounds or more per acre. A few green plants were present on the plots receiving 40 pounds of TCA. Live stolons are still present on all plots. This experiment was repeated on an area where quack grass had grown undisturbed during the summer. Sprays were applied August 10. Treatments on this area did not appear to be as effective as the one just described. Heavier applications were required to produce a comparable kill of quack grass. Applications of 150 pounds was the only rate that prevented resprouting when observed on October 14. (Contribution from the Department of Botany and Plant Pathology, Agricultural Experiment Station, Purdue University.)

Treatment of quack grass with TCA in 1949 at Huron, South Dakota. MacDonald, W.P., A.T. Slough, and C.C. Zinter. Seventy percent sodium TCA was applied June 8 at 10, 20, 40 and 80 pounds of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod but rough from plowing 2 years previous. Light sandy soil. At time of treatment soil moisture was good with quack starting to head at 18 in. Following treatment, June precipitation was 1.41 inches; July 0.99; Aug. 2.60; Sept. 2.29. Estimated reduction of top growth on September 13: 10 lbs. 32%; 20 lbs. 90%; 40 lbs. 95%; 80 lbs. 97%. (Contribution from the Agricultural Department, F.H. Peavey & Company, Minneapolis.)

Treatment of quack grass with TCA in 1949 at Lily, South Dakota. MacDonald, W.P., A.T. Slough, and C.C. Zinter. Seventy percent sodium TCA was applied June 9 at 10, 20, 40 and 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was mostly covered with quack sod. One set of replications on rough ground because of plowing at least two years previous. Sandy loam soil. At time of treatment soil moisture was fair and quack 4 to 8 inches high. Following treatment, June precipitation was 1.25 inches; July 3.35; Aug. 0.25; September 2.25. Estimated reduction of top growth on September 13: 10 lbs. 41%; 20 lbs. 58%; 40 lbs. 82%; 80 lbs. 96%. Plot area was rolling with better control noted at all rates on higher ground. (Contribution from the Agricultural Dept. F.H. Peavey & Company, Minneapolis.)

Treatment of quack grass with TCA in 1949 at Starkweather, North Dakota. MacDonald, W.P., A.T. Slough and C.C. Zinter. Seventy percent sodium TCA was applied June 16 at 10, 20, 30, 40, 60 and 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod but very rough from plowing the previous season. Sandy loam

soil. At time of treatment soil moisture was good with quack 10 to 14 in. high and heading. Record of precipitation following treatment not available but it was considered a very dry season in the area. Estimated reduction of top growth on September 14: 10 lbs. 32%; 20 lbs. 52%; 30 lbs. 63%; 40 lbs. 55%; 60 lbs. 78%; 80 lbs. 89%. (Contribution from the Agr. Dept., F.H. Peavey & Co., Minneapolis.)

Treatment of quack grass with TCA in 1949 at Baldwin, North Dakota. MacDonald, W.P., A.T. Slough, and C.C. Zinter. Seventy percent sodium TCA was applied June 8 at 10, 20, 30, 40, 60 and 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. per acre. Area treated was completely covered with quack sod and had not been disturbed for several years. Good sandy loam soil. At time of treatment, soil moisture was good with quack 10 to 14 inches high and heading. Following treatment, June precipitation was 0.56 inches; July 2.70; Aug. 1.86; Sept. 0.32. Estimated reduction of top growth on September 13: 10 lbs. 52%; 20 lbs. 47%; 30 lbs. 80%; 40 lbs. 93%; 60 lbs. 91%; 80 lbs. 97%. (Contribution from the Agr. Dept. F.H. Peavey & Co. Minneapolis.)

Treatment of quack grass with TCA in 1949 at Redwood Falls, Minnesota. MacDonald, W.P., A.T. Slough, and C.C. Zinter. Seventy percent sodium TCA was applied June 7 at 10,20, 40 and 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completed covered with quack sod which had not been distrubed for several years. Good loam soil. At time of treatment soil moisture was good with quack 18 in. high and heading. One-half of each plot was mowed and the hay removed. Following treatment, June precipitation was 1.08 inches; July 3.82; Aug. 1.37; Sept. 0.92. Estimated reduction of top growth on September 12: 10 lbs. mowed, 40%--unmowed 57%; 20 lbs., mowed 50%--unmowed 95%; 40 lbs., mowed 58%--unmowed 75%; 80 lbs., mowed and unmowed, 97%. (Contribution from the Agr. Dept., F.H. Peavey & Co., Minneapolis.)

Treatment of quack grass with TCA in 1949 at Warren, Minnesota. MacDonald, W.P., A.T. Slough, and C.C. Zinter. Seventy percent sodium TCA was applied June 16 at 10, 20, 30, 40, 60 and 80 lbs. of acid quiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was uniformally covered with quack and other perennial grasses. It was part of a golf course which had not been disturbed for several years. Fairly heavy clay soil. At time of treatment soil moisture was good with quack 6 to 8 in. high and heading. Following treatment, June precipitation was 1.87 inches; July 3.44; Aug. 1.99; Sept. 0.50. Estimated reduction of quack top growth on Sept. 15: 10 lbs. 7%; 20 lbs. 17%; 30 lbs. 26%; 40 lbs. 17%; 60 lbs. 28%; 80 lbs. 42%. (Contribution from the Agr. Dept., F.H. Peavey & Co., Minneapolis.)

Treatment of quack grass with TCA in 1949 at Breckenridge, Minnesota. MacDonald, W.P. A.T. Slough and C.C. Zinter. Seventy percent sodium TCA was applied June 14 at 10, 20, 30, 40, and 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod and had not been disturbed for two seasons. Heavy clay soil. At time of treatment the soil was dry with quack heading at 6 to 9 in. Following treatment, June precipitation was 0.32 inches; July 9.91; one rain inundated the plots for several days. Estimated reduction of top growth on September 16: 10 lbs. 27%; 20 lbs. 57%; 30 lbs. 70%; 40 lbs. 73%; 80 lbs. 93%. September readings made difficult by an extremely heavy stand of setaria which had completely taken over the plots. (Cont. of Agr. Dept., F.H. Peavey & Company, Minneapolis.)

Treatment of quack grass with TCA, #1 fuel oil, Chlorosal-A, and General Chemical 73-D in 1949 at Halstad, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent TCA was applied June 23 at 10, 20, 30, 40, 60 and 80 lbs. of acid equiv. per acre. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Chlorosal-A was applied at 38.5 lbs. and 77 lbs. of active ingredient per acre. General Chemical 73-D was applied at 20 gal. with 69 gal. of fuel oil; 20 gal. with 158 gal. of oil; 15 gal. with 118.5 gal. of oil; 10 gal. with 79 gal. of oil; 10 gal. with 168 gal. of oil and 178 gal. of #1 fuel oil was applied without additives. Area treated was completely covered with quack and other grasses and had not been disturbed for two years. Heavy clay loam soil. At time of treatment soil moisture was fair and quack heading at 24 in. Following treatment, June precipitation was 0.32 inches; July 7.63; Aug. 1.35; Sept. 0.48. Estimated reduction of top growth on Sept. 16: TCA - 10 lbs. 22%; 20 lbs. 23%; 30 lbs. 43%; 40 lbs. 54%; 60 lbs. 62%; 80 lbs. 84%. Chlorosal-A - 38.5 lbs. 13%; 77 lbs, 15%. General Chemical 73-D - 20 gal. 69 gal. oil 40%; 20 gal. 158 gal. oil 65%; 15 gal. 118.5 gal. oil 27%; 10 gal. 79 gal. oil 23%; 10 gal. 168 gal. oil 55% and 178 gal. #1 fuel oil without additives 30%. Presence of other stands relatively undamaged. One month after treatment all chemicals and rates showed better than 90% control of top growth. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis)

Response of quack grass (Agropyron repens) to TCA treatments, 1949. Thomas K. Pavlychenko. On the solid sod of quack grass, plots 8 by 13 feet in size were treated on July 11, 1949 with the sodium salt of trichloroacetate at rates of 25, 50, 75, 100, 125, 150, 175, and 200 lbs. of acid equivalent per acre. The infestation grew on disced summerfallow and the plants were from 6 to 10 inches in height. Soil was a silty clay loam. From the time of treatment until late in the fall, rains were frequent and provided good conditions for regrowth. Results: In plots treated at the rates of 25 to 75 lbs./a inclusive, some regrowth was invariably present. For instance, 20% (25 lbs./a.); 8% (50 lbs./a.); and 3% (75 lbs./a). Plots treated with the rates of 100 lbs./a. or more all remained dry until the freeze-up, with no green shoots recorded. The roots in these plots looked dead but their actual mortality will be ascertained only by the final records in 1950. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

TCA on quack grass at low doses. Shaw, W. C. and C. J. Willard. Sodium TCA at 20 lbs per acre applied to quack grass infested soil in August 1948, at once after plowing and working down to a seed-bed, (1948 Res. Report, Abstract VII-13) resulted in over 90% control when examined this spring. On May 15, 1949, sodium TCA was applied at 20, 40, 80, and 160 lbs. per acre to both recently plowed and fitted and unplowed quack. All rates were effective, the kill on the plowed areas being somewhat better than on the unplowed. A few sprouts are visible now (October) in all plots, nearly as many in the 160# plots as in the 20# plots. A second test in August 1949, followed by three weeks of dry weather, appeared less effective, but no final results are yet available. (Contribution of the Ohio Agr'l. Experiment Station.).

Control of quack grass (Agropyron repens) with TCA. Slife, F. W. and Fuelleman, R. F. The sodium salt of TCA has been applied to established stands of quack grass in April, June, and August of 1949 at Urbana, Illinois. Rates used were 25, 50, 75, and 100 lbs. of the acid per acre. None of these rates were effective when applied on April 7. TCA applied on June 7 to previously clipped quack grass at the rate of 75 lbs. per acre gave 100% control. Rates as low as 25 lbs. per acre applied in August destroyed all top growth, but on October 19, examination of the rhizomes on all plots indicates that regrowth has again started. Rain fell within 2 days after the June 7 application and continued above normal during the ensuing month. Six weeks after the June 7 application annual weeds began to grow vigorously

on the 75 and 100 lb. plots. The weeds were crabgrass (Digitaria sp.). In northern Illinois at the DeKalb Experimental Field, applications made in June were less effective; only 90% control was obtained with 125 lbs. of TCA acid per acre. Complete control was obtained when 150 lbs per acre was used. This area was not clipped before treatment and rainfall was well below normal during the summer. A few annual weeds appeared on the 75 and 100 lb. plots in late September. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Effects of new chemicals on quack grass (Agropyron repens). Slife, F. W. and Fuelleman, R. F. Chlorosol A was applied to establish stands of quack grass in June of 1949 at 25, 50, 75, and 100 lbs. per acre. Three weeks later a slight discoloration of leaves was evident. Observations on October 17, indicated little or no damage to the quack grass at any of the above rates. Potassium thiocyanate was used at 100, 200, and 300 lbs. per acre on quack grass. Applications were made in June and August. Applications of 300 lbs. on both dates have given 100% control and 200 lbs. have given 70% control. Nitrogen in the form of ammonium nitrate has been applied to quack grass in combination with other chemicals. Applications of 80 lbs. elemental nitrogen plus 25 lbs. TCA, 80 lbs. N plus 50 lbs. TCA, 80 lbs. N plus 4 lbs 2,4-D, and 80 lbs. N plus 8 lbs. of 2,4-D, were made in June of 1949. The 2,4-D-nitrogen combination gave control all season, but did not reduce the stand to any extent. TCA-nitrogen gave only partial control. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Eradicating quack or twitch grass with sodium trichloroacetate (TCA) and Chlorosol-A. Wood, H. E., J. J. Bourns, and H. J. Mather. Quack grass (Agropyron repens) on clay soil in Winnipeg was treated on three dates with TCA and on two dates with Chlorosol-A. Both were applied with knapsack sprayer using 110imperial gallons/A of water. The periods for TCA were, 1) early spring - May 21, 2) midsummer - June 27 with plants in flower and 3) late summer - August 8 with seed ripe. TCA was applied on May 21 at 30, 60, 90, and 120 lb./A and on June 29 and Aug. 8 at 60, 90, 120, and 150, lbs./A On June 27 an extra series of plots was treated where grass was mown about 2 in. from ground. Several plots at other locations were also treated. Final appraisal cannot be made until 1950 but these results were rated: 1) less than 90 lb. gave only partial eradication, 90 lbs. looks promising and 120 and 150 lbs. decidely promising; 2) results have been substantially the same for all three dates; 3) results were immediate and more definite on mown plots and 4) perennial sow thistle, Canada thistle and snowberry (Symphoricarpos albur) were killed back but recovered and brome grass showed almost complete survival. Chlorosol-A was used 50, 100 and 150 lbs./A on May 27 and on June 27 at 110, 220, and 440 lbs./A. Of the May 27 treatments 150 lb. gave slight browning but there was no effect from others. Very little effect was noted from oven the heaviest dosage of June 27. (Contribution of the Weeds Commission, Manitoba Department of Agr., Winnipeg, Canada.)

Bermuda and Johnson Grass

Johnson and Bermuda grass control with TCA. Elder, W. C, and Stephens, J. P., r. 60% sodium trichloroacetate was applied on Johnson and Bermuda grasses at monthly intervals during the growing season at the rate of 50-100-150 lbs. per acre of the active ingredient. Johnson grass was treated at several stages of growth, from a closely mowed up to 24" high and also on infested land that had been plowed. Bermuda was clipped 1-2" high before treatment. Applications made in May and early June on Johnson grass killed 60-75%. July and August treatments had estimated kills of 90-99%. September and October applications made in 1948 were unsatisfactory on Johnson grass. Some grass recovered from all treatments, with the 50 lb. rate always showing the most; however, the 150 lb. rate did not show advantage over the

100 lb. rate. This investigation indicated that clipping Johnson grass or cultivation of the soil just before treatment gave less control than when the grass was 12-18" high at time of treatment. Bermuda grass applications made in April and May were unsatisfactory, but very good for June, July, August, September, and October. Some recovery was noticeable on 50 lb. per acre plots. Rates above 100 lbs., however, did not show an advantage. (Contributed by Agronomy Department of the Oklahoma A. & M. College Experiment Station.)

Effect of methyl bromide on Bermuda, Johnson and nut grass. Elder, W. C. Methyl bromide containing 2% chloropocrin was released under gasproof paper covering the grasses. The paper was removed after 30-40 hours exposure. Rates of 1 lb. per 100 sq. ft. were used on all grasses and ½ lb. was used on Bermuda grass. Applications were made on moist soils. Plots were on infested areas where the soil had been recently cultivated and on undisturbed soil with some of the growing vegetation exposed. Bermuda and Johnson grasses were killed by all treatments except where the vegetation was large at time of treatment. Where the grasses were clipped close to the ground and the forage removed from the area, eradication was complete. The nut grass plots were treated late in the season and final readings cannot be made until next year; however, the treatments look promising since the area is free of new growth 90 days later.

Twenty-four hours after the covers were removed from the treated areas, crops were planted and made normal growth. Evidently many of the weed seed were killed by the gas as the cultivated plots were free of weeds the entire summer. (Contributed by Agronomy Department of the Oklahoma A. & M. College Experiment Station.)

Effect of TCA on Johnson grass (Sorghum halepense.) Lee, Oliver C. Replicated plots of Johnson grass were treated with TCA at rates of 40, 80, 100, 120, and 160 pounds of acid per acre in August of 1948. The area treated was located in an alfalfa field that had been clipped twice during the summer. Johnson grass at the time of treatment was approximately 18 inches in height. All rates of applications destroyed top growth. The following spring the area was disked and seeded to oats and alfalfa. In August of 1949 an average of 3 plants of Johnson grass per square rod were found on plots treated with 120 and 160 pounds of TCA. Amounts of 40, 80, and 100 pounds reduced the stand of Johnson grass but is not considered adequate control or eradication. Oats and alfalfa seed in March of 1949 grew normally on all treated and check plots. Other plots were treated in June, July and September of 1949 using rates of 40, 80, and 100, 120 and 160 pounds of TCA acid per acre. One series of plots sprayed on September 21 were disked twice to keep down top growth during August and September prior to spraying. Results of 1949 sprayings will be determined in 1950. (Contributed by Department of Botany and Plant Pathology, Agric. Expt. Sta., Purdue University.)

TCA for the control of Johnson grass along irrigation ditch banks. McCall, G. L. and J. W. Lahnley. Sodium TCA, applied June 30, 1949, at the rates of 1, 1½, and 2 lbs. per square rod to the uncut tops of Johnson grass growing along irrigation ditches successfully eliminated 87, 93, and 96% respectively of the established stand. Although for practical purposes the original stand was controlled, Johnson grass seed in the soil germinated the following spring and the plants made normal growth. TCA will control established stands of Johnson grass but retreatment will be necessary to control seedlings. It may be desirable to apply somewhat less in the original treatment and use dosages in the neighborhood of 50 lbs. per acre the following year to eliminate the surviving old plants and seedlings. (Contribution of the Kansas Agricultural Experiment Station.)

Project II. Herbicides in Control of Annual Weeds.

Summary

Investigation Leader: A. H. Larson

Reports this year have been largely in relation to several herbicides and their effects on a limited number of common annual weeds, when applied at different rates, in different ways and at different times, indicated by stages of development either of the weeds or of the crops with which they were growing. The tendency was to retain the rates within the economical range.

Comparisons were made between the acid of 2,4-D sodium salt, triethanol amine salt, and butyl ester, ethyl ester and isopropyl ester of 2,4-D. Also considered were isopropyl ester of 2,4,5-T, butoxy ethanol ester of 2,4,5-T and A.C.P. Brush-killer #32. Other chemicals used were: Sinox, Dow's Selective Herbicide, Sodium Trichloroacetate, various mixtures, Experimental Herbicide #1, Sulfosan, several A.C.P. preparations, P.C.P., and Cyanamid.

The weeds considered were: Tartary Buckwheat, Wild Radish, Ball Mustard, Lamb's Quarters, Stinkweed, Mare's Tail (Erigeron canadensis), Russian Thistle, Wild Buckwheat, Pigweed, Annual Wild Sunflower, Treacle Mustard, Wild Oats, and Green Foxtail. Crop plants considered were: Flax, Oats, Red Clover, and sweet clover.

Evidentally, weather and soil, as they affect the rate of growth of weed plants, greatly affects the efficiency of the herbicide. Rapidly growing plants were most susceptible. Also the stage of growth is a big factor in determining the degree of kill or control of weeds. The younger plants succumbed most readily. Plants approaching the blooming stage were more resistant to 2,4-D and other herbicides. Plants with well-developed fruits or pods were most resistant. Some plants were retarded or stunted but not killed, such as Wild Buckwheat. One report mentioned about an increase in yield of wheat by 2,4-D treatment when kept below eight ounces per acre.

Of the 2,4-D formulations, the esters were reported to be somewhat more effective followed by the amine salts and sodium salt. When applied alone 2,4,5-T was no more effective in weed control than the amine or sodium salts of 2,4-D usually 2/3 to 7/8 when compared.

T.C.A. when applied at the rate of 48# per acre, reduced flax stands without any appreciable control of Wild Oats or Green Foxtail. P.C.P. at 8# per acre in water lowered the yield of flax when applied seven days after seeding.

Good results were reported in the control of Wild Radish and Lamb's Quarters when treated with amine salt and ester of 2,4-D at the rate of two, four, and eight ounces per acre; 1½ and three quarts of Dow's Selective Herbicide; and Cyanamid special grade (dust) at 100# per acre, without any apparent injury to the red clover, when applied at the time of heading of the oats. Volunteer sweet clover was killed the second year in the rosette stage by eight ounces of butyl ester. When the sweet clover was twelve inches tall, sixteen ounces of 2,4-D resulted in only partial killing of the stems which was followed by a thick regrowth from crown buds. Sinox was used only on Tartary Buckwheat with only slight effects when applied during the seedling stage of growth.

The reports submitted scarcely warranted the formulation of any recommendations as to the use of the chemicals at this time.

Abstracts of Cooperators

Eradication of volunteer sweet clover by the use of 2,4-D. Carder, A.C. The butyl ester of 2,4-D was applied at 4, 8, 12 and 16 ounces acid equivalent per acre to second-year Arctic sweet clover when in the rosette, 6 inches and 12 inches high. Weather was ideal for treatment at all three dates of application. Results indicate the clover to be most vulnerable to 2,4-D when at the 6-inch stage. Treated at this period, 4 ounces of the ester gave over 80 per cent control while 8 ounces effected total elimination. When the clover was treated in the rosette stage the comparable kill by these rates was 53 and 95 per cent, respectively; while when in the 12-inch stage even 16 ounces resulted in frequent instances of partial killing of the stalks only, followed by a thick regrowth from buds below the killed portion. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Effects of Sinox, 2,4-D, 2,4,5-T and mixture of 2,4-D, 2,4,5-T on Tartary Buckwheat. Corns, W.G. Field plots of buckwheat from spring-planted seed (Density about 95 plants sq.yd.) were treated at seedling stage (2 weeks after emergence) and at bud stage (7 weeks after emergence) with Sinox at rates of 0, 5/8, 1, 1½ gallons in 100 gallons of water per acre, and with Green Cross butyl ester of 2,4-D, Naugatuck isopropyl ester of 2,4,5-T, and A.C.P. Brush Killer #32; 2,4-D with 2,4,5-T butoxy ethanol ester, at rates 6, 10, 16 ounces acid equivalent in 20 gallons of water per acre. Weather was very dry during the spring and early summer. Sinox had only slight effect at Stage 1, practically no effect on Stage 2. Five weeks after seedling treatment 6 ounces of 2,4-D caused 37% reduction in numbers, 80% reduction in fresh weight of plants, and at harvest time 2½ months after Stage 1 treatment. 30% reduction in numbers, 50% reduction in weight. At the same times, 10 ounces of 2,4-D caused 80% reduction in numbers, 93% reduction in weight, and 55% reduction in numbers, 67% reduction in weight, respectively. Sixteen ounces of 2,4-D caused 90% reduction in numbers, 99% reduction in fresh weight 5 weeks after Stage 1 treatment, and 87% reduction in numbers and in fresh weight at harvest time. Comparable 2,4-D, 2,4,5-T and Brush Killer treatments at budding stage suppressed growth somewhat, but were of negligible value. Results from 2,4,5-T applied at seedling stage were greatly inferior to those from 2,4-D. Brush Killer application at seedling stage was about 2/3 to 7/8 as effective as comparable 2,4-D treatment. (Contribution of Department of Plant Science, University of Alberta.)

The use of 2,4-D in the control of Russian thistle (Salsola pestifer) in crop also infested with wild buckwheat (Polygonum convolvulus). Coupland, R. T. Rod-wide strips were treated across a field of wheat on fallow on sandy loam dark-brown soil on June 5, 1949. Triethanolamine and isopropyl ester forms of 2,4-D were used at 4 and 8 ounces per acre in 4 gallons of water. The wheat (seeded on April 30) was 6 to 7 inches in height. Salsola, which was the predominant weed, was up to 4 inches in height. Good control of Salsola resulted by leaf curling, dwarfing and killing. Polygonum became abundant during July. Data were taken from 10 plots, each 4 square yards in area, in each strip at harvest on August 18. Wheat yields were increased over adjacent untreated checks by 31 and 28 per cent with treatments of amine at 4 and 8 ounces and by 6 and 44 per cent with treatments of ester at 4 and 8 ounces per acre, respectively. When mean differences between paired plots in adjacent strips were compared, the increased yields from amine were significant at the 5 per cent point, while that of the ester at 8 ounces was significant at the 1 per cent point. No significant difference was shown between formulations or between two rates of amine. Ester at 8 ounces resulted in a yield of wheat significantly above the 4-ounce rate. Yields of Polygonum were increased over controls by 46 and 51 per cent with 4 and 8 ounce rates of amine and by 3 and

11 per cent with ester at 4 and 8 ounces, respectively. This increase was significant only in the amine treatment at 8 ounces. Hence, it seems pertinent when treating with 2,4-D where different susceptibility exists, that the treatment should be planned to combat the most resistant. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Response of wild oats (Avena fatua) and green foxtail (Setaria viridis) to sodium trichloroacetate. Coupland, R. T. Avena fatua and Setaria viridis were seeded between rows of Argentine rape 6 inches apart. Emergence of crop and weeds was delayed until June 8 because of deficient soil moisture. Duplicated applications of 2, 4, 8 and 12 pounds per acre of active sodium trichloroacetate per acre were made in 10 gallons of water. Treatments were made on June 21, when the rape was 2 to 3 inches in height and the grasses were in the 3 to 4 leaf stage, on July 6, and were repeated on both these dates. No damage occurred to the weedy grasses which could be attributed to the effect of the chemical. Competition of the rape was a more significant factor than was the effect of the chemical. This competition eliminated Setaria, which is adapted to coarse-textured soils, but did not prevent Avena from producing seed. Under the conditions of this experiment concentrations of sodium trichloroacetate up to 12 pounds of active ingredient per acre, even when applied twice during vegetative development, did not affect the growth of Avena fatua appreciably. Preliminary tests of susceptibility of weeds to chemicals should not be conducted while the weed is competing with a crop unless the weed is known to be adapted to the soil type and climate and to be able to compete with the crop. Otherwise, competition may be more significant in reducing the vigor of the weed than is the herbicide. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Effect of 2,4-D as a selective herbicide on annual weeds in spring-planted wheat. Friesen, H. A. Three formulations at six rates, viz: 2, 4, 6, 8, 12 and 16 ounces of acid per acre were sprayed on Rescue wheat infested with stinkweed (Thalspi arvense), Russian thistle (Salsola kali), lamb's quarters (Chenopodium album), and wild buckwheat (Polygonum convolvulus). The sprayings were made at four stages of weed growth vis: 1 - seedling stage, 2 - pre-bud stage, 3 - bud stage, and 4 - bloom stage. Weather conditions were favorable for rapid growth.

Excellent kills of stinkweed, Russian thistle, and lamb's quarters resulted from all dosages of the ester and amine applied at the first two stages. Russian thistles showed more tolerance to amine than to ester at the two-ounce rate. The sodium salt was ineffective at less than 8 ounces per acre. Wild buckwheat was stunted but not killed.

At the bud stage Russian thistle and lamb's quarters required 6 ounces of ester and 8 ounces of amine for control while stinkweed was effectively controlled by 4 ounces of amine or ester. Control of these weeds when in flower required dosages of not less than 8 ounces ester and 12 ounces amine. Wild buckwheat was resistant to all treatments. The sodium salt was ineffective at the latter two stages.

At the first two stages, all treatments which results in excellent control of weeds (except wild buckwheat) resulted in marked yield increases of wheat. Exceptions being the 12 and 16 ounce rates of ester and 16 ounce rate of amine, which depressed the yield significantly. Treatments in the bud and flowering stages were too late to significantly affect the wheat yields. (Contributed by the Dominion Experimental Station, Scott, Sask.)

The effect of various chemicals at several rates of application applied as pre-emergence sprays on flax at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Plots of flax were treated in triplicate 4 days after seeding and 7 days after with 1 or 1½ pounds acid per acre of triethanol amine salt or micronized acid of 2,4-D; 2 or 3 pounds acid per acre of Experimental herbicide No. 1; 2 or 4 pounds per acre of Sulfosan; 20 or 40 pounds acid per acre of TCA; 8 or 16 pounds in water or 8 pounds in oil of PCP. Wild oats (Avena fatua) and other common annual weeds were sown with the flax on one-half of each plot. Weed counts were made on June 28. Extreme drought conditions reduced flax yields. No material difference was found in weed counts between untreated and treated plots. An analysis of variance indicates that yields were changed by rates of some chemicals and an L.S.D. at the 5% level indicates the TCA at 20 or 40 pounds per acre and PCP at 8 pounds in water lowered the yields significantly when applied 4 days after seeding. TCA at 40 pounds per acre significantly lowered the yield when applied 7 days after seeding. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

The effect of treating wild oats (Avena fatua) seeded with flax with TCA at four rates of application and TCA - 2,4-D mixture at two rates of application at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Plots of flax were treated in triplicate with Sodium trichloroacetate at 6, 12, 24, and 48 pounds of the acid per acre and with a mixture of TCA 12 pounds per acre plus triethanol amine salt of 2,4-D ¼ pound per acre and TCA 24 pounds plus 2,4-D ¼ pound per acre. Half of the plots were seeded to wild oats (Avena fatua) and other annual weeds when the flax was seeded. A dry period immediately after seeding prevented germination and stunted the seedling plants of both flax and weeds. Treatment was made June 6, 1949 when the flax was 8 inches tall and the wild oats and other weeds were 2 to 3 inches high. Weed counts were made on June 28, 1949. At no rate of the TCA alone was there any material control of wild oats and other weeds. When 2,4-D was mixed with TCA the annual broadleaf weeds such as lamb's quarters (Chenopodium album) and kochia (Kochia scoparia) were eliminated nearly 100 per cent. An analysis of variance of the yields indicated a significant difference in treatments. An L.S.D. at the 1 per cent level showed all treatments in the wild oats plots except TCA at 6 pounds per acre to have reduced the yields significantly. TCA at 48 pounds on the wild oats free flax lowered the yield significantly at the 1 per cent level. TCA at 12 pounds - 2,4-D ¼ pound lowered the yield significantly at the 5 per cent level. Results indicate TCA will reduce flax yields without controlling the grassy type weeds. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

Use of selective herbicides in controlling weeds in red clover seeded with oats. Leefe, J.S. Amine salt and ester of 2,4-D at 2, 4, and 8 ounces acid per acre, Dow's Selective Herbicide at 1½ and 3 quarts per acre, and Cyanamid special grade (dust) 100 pounds per acre were applied to red clover seeded down with oats. Materials were applied at shooting and heading stage of oats. The field was infested with wild radish (Raphanus raphanistrum) and to a lesser extent with lamb's quarters (Chenopodium album). All treatments gave good control of wild radish. The two ounce rates of 2,4-D gave only limited control of lam's quarters. The stand of red clover was not reduced by any one of the treatments at either date of application. (Contribution of Dominion Experimental Station, Kentville, N.S.)

Effect of two formulations of 2,4-dichlorophenoxyacetic acid formulations sprayed at 3 rates and 2 stages of growth on annual weeds in crop. Ball Mustard (Neslia Paniculata), Lamb's Quarters (Chenopodium album), and Stinkweed (Thlapsi Arvense). Leggett, H. W. The two formulations used were triethanolamine and butyl ester and the rates 4, 8, and 12 ounces of acid per acre. It was extremely hard due to the unseasonable weather to define the stages but they mostly went into the following. Stage 1 - seedling to bud and in the case of the stinkweed, some developed to the pod stage. Stage 2 - flower to pod stage and maturity. Five (square yard) weed counts were taken from all plots. In stage 1 the overall kill was good in all rates, and formulations. The lamb's quarters and stinkweed showed up as more susceptible than the ball mustard and stinkweed plants beyond the flower stage showed high resistance even at high rates. The butyl ester was slightly the better. In Stage 2 the overall kill was from 57% to 100% depending on the type of weed, while in Stage 1 the range was from 65% to 100%. Lamb's quarters showed very little reduction in susceptibility. Stinkweed, in the pod stage, showed a reduced susceptibility to the amine application at 4 ounces, and to a lesser extent in ester. With 4 ounces, ball mustard became partially resistant in Stage 2. The amine also showed a marked reduction in kill at 4 ounces. Fair results were achieved at the higher rates of 8 and 12 ounces. (Contribution of Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada.)

Testing the possibilities of controlling Tartary Buckwheat (Fragopyrum tartaricum) with various systemic herbicides, 1949. Pavlychenko, Thomas K. Quadruplicate plots of Tartary buckwheat were treated with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), ACP 638, 472, (acid of 2,4-D) ACP 648, 646, 675, and 649 (all 2,4-D formulations) at 1 and 2 pounds/a. rates as pre-emergence and at 8 ounces/a. rate as post-emergence applications. Check plots had 90 to 100 per cent stands. Growth in checks was very vigorous. It was cut prior to maturity. Stand and dry weight of the top growth from 8 feet row samples was determined from the experimental and check plots. Results: In pre-emergence treatment only ACP 472 at 2 pounds/a. rate gave clear-cut evidence of an effective control of this weed. At 1 pound/a. rate it reduced stand by 70 per cent and dry weight by 83 per cent. At 2 pounds/a. rate only 5 per cent plants survived and gave dry eight of 6.5 per cent of the check. ACP 649 at 2 pounds/a. rate reduced the stand by 70 per cent and dry weight by 87 per cent., ACP 675 by 68 and 70 per cent respectively. The corresponding figures for ACP 646 were 49 and 70 per cent. The other chemicals were much less effective. Weedar 64 in oil, ACP 646, 675 and 649 were also applied at 8 ounces/a. rate as post-emergence treatment, when the weed was 4 or more inches high. Weedar 64 in oil produced a 100 per cent kill, ACP 675 and 649 reduced the stand by 50 and 98 per cent and the dry weight by 89 and 98 per cent respectively. ACP 646 has reduced stand by 40 and the dry weight by 77 per cent. It appears there are possibilities of controlling this weed with some of the new formulations. (Contribution of Agr. Division, American Chemical Paint Company, Saskatoon, Sask.)

A comparative test of 2,4-D esters for volatility and weed kill, 1949. Pavlychenko, Thomas K. ACP 683, a new non-volatile ester of 2,4-D was tested for volatility side by side with Weedone Concentrate 48, and ethyl ester. 8 x 30 feet plots infested with young stinkweed, Russian thistle, wild buckwheat and pigweed were treated with the two esters at 4 and 6 ounces/a rates. Checks 16 x 30 feet were provided on each side. Drift into the check plots was fully controlled. Immediately after spraying, young 1-3 inches high tomato plants, in pots, were planted in each experimental and control plot. The tomatoes in the experimental plots were placed at equal intervals along the longtitudinal axis. In check plots these were spaced equally along the diagonal line at 1, 3, 5 and 8 feet distances from the treated plots. Observations were made daily until the first killing fall frost. Results: The test plants in the experimental plots treated with ACP 683 at both rates showed no effect of the chemical during the entire test period. The same was true of the plants grown in the checks. The plants in the Weedone Concentrate 48 plots were badly twisted 2 hours after the treatment and some of these died several days later. Others finally survived after a prolonged period of recovery. The tomatoes in the control plots in close proximity to the treated plots were affected but finally recovered. ACP 683 was somewhat more effective on weeds than Weedone Concentrate 48. It gave 95 to 98% kill of stinkweed at the 4 and 6 ounce/a. rates respectively. The corresponding figures for Weedone Concentrate 48 were 90 and 97%. Both esters produced a permanent stunting of Russian thistle. At the rates used they only retarded the normal development of wild buckwheat and the amarathus species. (Contribution of Agr. Division, American Chemical Paint Company, Saskatoon, Sask.)

Comparative effectiveness of 2,4-D formulations and 2,4,5-T on a mixed stand of annual weeds at Hays, Kansas. Phillips, W. M. Randomized square rod plots of annual weeds were treated in triplicate on two dates, May 12 and May 26, with an ester, an amine, and a sodium salt of 2,4-D and an ester of 2,4,5-T at the rates of 1/8, 1/4, 1/2, and 1 pound acid per acre. Weeds predominating were: treacle mustard (Erysimum repandum), lamb's quarters (Chenopodium album), Russian thistle (Salsola kali var tenuifolia), mare's tail (Erigeron canadensis), and sunflower (Helianthus annuus). Rainfall during April and May was slightly below normal but sufficient for adequate plant growth. Results from both dates of application indicate that the ester of 2,4-D was the most effective in controlling the annual weeds present. Approximately twice the dosage of the other chemicals was necessary to give comparable control. The ester of 2,4,5-T was no more effective than the amine or sodium salt of 2,4-D. In nearly every case more satisfactory control was obtained from the May 12 treatment. At the time of the May 26 treatment some of the weeds had begun to set seed and mature. (Contributed by Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. D. A., Hays, Kansas.)

Project III-4. Effect of Herbicides in Growing Crops.

Corn

Investigation leader: Oliver C. Lee

Summary

Corn was found to be least tolerant to 2,4-D when sprayed at heights from 10 to 36 inches. Generally this is the stage of most rapid growth. Least damage occurred when sprayed at 2 to 4 inch heights. Tolerance or damage is determined by the degree of brittleness, lodging, curvature of stalks and development of abnormal brace roots. Such malformations in growth may or may not effect yields. Reduction in yield is usually the result of reduced stands due to breakage of stalks during the period of brittleness following spraying. Symptoms of injury generally increased as rates of application of 2,4-D were increased. Plots sprayed with amine salts gave slightly higher yields and showed slightly less damage to corn than the ester formulation.

Inbred lines tested were found to vary in their tolerance. The reaction of an inbred parent is generally reflected in its hybrids; however, hybrids appeared to be more sensitive to 2,4-D than inbreds, probably due to increased growth rate.

Corn will tolerate respraying with 2,4-D either as two post-emergence or as one pre-emergence and one post-emergence treatment. The degree of injury in the case of corn resprayed was about equal to first sprayings at corresponding stages of growth.

Plots receiving chemical treatments alone, without cultivation, yielded less than those receiving cultivation. Soil type and degree of infestation of grassy weeds are factors that determine the need for cultivation. Adequate weed control is essential to maximum yields of corn. Whether this should be obtained by spraying or cultivation or a combination of the two will depend upon the weed problem at hand.

Abstracts of Results of Cooperators

The effect of retreatment, post-emergence 2,4-D on corn. Aldrich, R. J. and C. J. Willard. Iowa 939 was planted May 18, 1949 on Miami silt loam at Columbus. All weeds were removed by hand. Experimental design was a split plot with three replications. Plots were 33 feet long x 4 rows wide with the center two rows harvested for yield. One half pound of the amine salt and the butyl ester formulation of 2,4-D was applied at the following six stages (measurements to tip of extended leaf): (1) 3 inches, (2) 21-31 inches, (3) #1 plus #2, (4) 8-10 inches, (5) 60-72 inches, and (6) #4 plus #5. With only one exception, the yields from retreated plots were lower, but probably not significantly, than yields from plots receiving either single treatment. There were no consistent differences in yields between the two 2,4-D formulations. (Contributed by Ohio Agricultural Experiment Station, Columbus, Ohio)

The effect of post-emergence 2,4-D on corn. Aldrich, R. J. and C. J. Willard. Iowa 939 was planted May 18, 1949. The soil was a Miami-Brookston complex. The experimental design was a split-split plot design with three replications. Plots were four rows wide x 33 feet long with data taken on the two center rows. The amine salt and the butyl ester formulations of 2,4-D were

applied at 1/2 and 1 pound, acid equivalent, per acre, to corn one, two, three, four, six and eight weeks after emergence. Brace root abnormalities were greatest at three weeks, progressively less at four, six and two weeks, with essentially no brace root damage at one week and eight weeks. More than 50% of the plants in plots treated at three and four weeks after emergence had abnormal brace roots. Plots treated at six and eight weeks after emergence with both chemicals at 1 pound per acre were considerably lodged. There was very little lodging at any other stage. The yields of plots treated one week after emergence were slightly, but not significantly, higher than the yields from the remaining stages. Yields were generally, but probably not significantly, lower from plots treated with the butyl ester than from those treated with the amine salt. (Contribution of Ohio Agricultural Experiment Station, Columbus, Ohio.)

The effect of pre- and post-emergence 2,4-D on corn. Aldrich, R. J. and C. J. Willard. Indiana 750 was planted April 27, 1949 on Fox silt loam at Chillicothe. The experimental design was a split-split plot design with three replications. Plots were 2 x 12 hills in size with 2 x 10 hills harvested for yield. Four cultivation practices were used - no cultivation, scraped and hoed, one cultivation, and three cultivations. One, two, and four pounds of the butyl ester of 2,4-D were applied pre-emergence May 2. One-fourth, one-half, one, and two pounds of the butyl ester were applied post-emergence two days after the corn was laid by. Drop booms were used in making post-emergence applications. Jimson weed and velvet-weed were predominant weeds. Two pounds 2,4-D pre-emergence gave good control of weeds with one pound slightly less effective and four pounds slightly more effective. All post-emergence rates gave effective weed control, but there was an indication that one and two pounds post-emergence gave pre-emergence control of late germinating weeds. Yields from uncultivated, untreated checks were approximately 1/3 as great as yields from untreated plots cultivated three times. Yields from untreated plots scraped and hoed and plots cultivated once were approximately 3/4 as great as yields from untreated plots cultivated three times. There was no significant difference in yields between untreated plots scraped and hoed and untreated plots cultivated once. 2,4-D in any combination did not increase or decrease the yields of plots cultivated three times. All pre- and post-emergence 2,4-D and all combinations of pre- and post-emergence on scraped and hoed plots and on plots cultivated once, gave yields equal to plots cultivated three times. No 2,4-D treatments increased yields of uncultivated plots equal to yields of plots cultivated three times, but combinations of pre- and post-emergence gave higher yields, probably significantly, than any single 2,4-D treatment. (Contributed by Ohio Agricultural Experiment Station, Columbus, Ohio.)

Relation of corn size at time of 2,4-D treatment to grain yield and plant injury. Buchholtz, K. P. Wisconsin hybrid 595 was sprayed with an amine preparation of 2,4-D at the 2, 5, 10, 24, 36 and 55 inch growth stages. One lb. of 2,4-D per acre was applied at all growth stages. At the 2 and 55 inch stages 2 lb. applications were made also. All applications were made as a top spray using 20 gallons of water except the 55 inch stage which was sprayed from the side only and the 36 inch stage which was both side and top sprayed. Examination of the growing point at time of each treatment showed that it emerged above the surface of the soil between the 10 and 24 inch stages. Corn plants sprayed at the 2 and 5 inch stages did not show a greater degree of stalk bending than check. Plants sprayed at the 10, 24 and 36 inch stages all showed severe stalk bending. The bending was most pronounced on the plots treated at the 24 and 36 inch stages. The response at the 55 inch stage was erratic and not as pronounced as at the

earlier stages. Stalk breakage was most severe on the plots treated from the top at the 36 inch stage. This treatment resulted in a stalk breakage of 44 percent. Plots with plants sprayed from the side on this date showed but 27 percent breakage. The yields of plots treated at the 24 inch stages was significantly less than check being but 41.2 and 39.1 bu. for the top spray applications and 60.1 bu. for the side spray applications in contrast to check yield of 72.3 bu. per acre. This reduction in yield is due in part to the increased stalk breakage on the plots. None of the other treatments reduced yields significantly. (Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.)

Tolerance of corn to 2,4-D applied at various stages of growth. Lee, Oliver C. To determine the tolerance of corn to various dosages of 2,4-D, applications of varying rates were made at different stages of growth on a series of replicated plots of corn (Indiana Certified hybrid 251) in 1948. Sprays were applied when corn was 4, 12 and 30 inches tall using 0.25, 0.5, 0.75 and 1.5 pounds of 2,4-D acid per acre. All plots were cultivated twice and weeds removed by hoeing. Rates of 0.75 and 1.5 pounds of 2,4-D caused considerable lodging and brittleness in corn following spraying. More proliferation of brace roots developed on corn sprayed when 12 and 30 inches in height than when sprayed at the 4 inch level. Moisture and temperature conditions were more favorable for rapid growth of corn at the time the corn was 12 and 30 inches in height than when 4 inches in height. Differences of yields in bushels per acre from plots sprayed at various heights and rates as compared to checks are as follows: 4 in. corn +2, -3, -1, -5; av. -1.75: 12 in. corn -1, -1, +1, -6; av. -1.75: 30 in. corn +6, +2, -8, -6; av. -1.5, for rates of 2,4-D at 0.25, 0.5, 0.75 and 1.5 pounds per acre respectively. The difference in yield are not significant. Growing conditions rather than size of corn apparently effected tolerance of corn to 2,4-D more so than stage of growth at time of spraying as exhibited by lodging and brittleness of corn plants. The proliferation of brace roots appear to be encouraged by the later sprayings. (Contribution of Purdue University Agricultural Experiment Station, Lafayette, Indiana.)

Tolerance of several inbred lines of corn to 2,4-D. Lee, Oliver C. The most popular inbred lines used in making certified Indiana hybrids were sprayed with 2,4-D at the rate of 3/4 pounds of acid per acre. An amine salt was used. Plants at the time of spraying were 20-30 inches in height. Moisture conditions and temperature were conducive to rapid corn growth at the time and following spraying. Sprays were applied on July 11 and observations made July 15 and again September 12. Susceptibility or tolerance of the inbreds to 2,4-D was determined by degree of lodging and brittleness as observed four days after spraying. Curvature of stalks and brace root development were evaluated on September 12. Considering these abnormalities, the inbred lines varied in susceptibility from tolerant to susceptible. 1948 experiments as well as those of this year indicate that the reaction of inbred lines that serve as parents of a hybrid is reflected in both single and double crosses. As a rule parent lines appear to be more tolerant to 2,4-D than the resulting hybrids. It is possible, however, that hybrid vigor in hybrids cause susceptibility to injury. (Contribution of Purdue University Agricultural Experiment Station, Lafayette, Indiana.)

Effect of rates of application of two formulations of 2,4-D when applied at two stages of corn growth. Lee, Oliver C. Corn was sprayed when 6 and 12 inches in height using both amine and an ester formulation of 2,4-D at the rates of 1/8, 1/4, 1/2, 3/4 and 1 pound per acre. Sprays were applied over the top of

corn using 12 gallons of water per acre. Growing conditions were very near the same at the times the two sprays were applied: temperature approximately 85° F, bright sunshine and soil reasonably dry. The only significant reduction in yield over check plots occurred where the ester formulation of 2,4-D was applied to the 6 inch corn in rates of 3/4 and 1 pound per acre. All plots were cultivated to remove weeds. Hand weeding was not employed as the field was reasonably free from weeds. There appeared to be more lodging and brittleness of corn plants where the ester formulation was used in rates of 1/2, 3/4 and 1 pound per acre than on the plots sprayed with the amine salt. Some leaf burn was noted from the 3/4 and 1 pound dosages of the ester formulation. In general more curvature of stalks and malformation of brace roots occurred on plots sprayed at the 12 inch height. This is especially true on plots receiving the heavier rates of 2,4-D. (Contribution of Purdue University Agricultural Experiment Station, Lafayette, Indiana.)

Effect of repeated spraying with 2,4-D on corn. Lee, Oliver C. Replicated plots of corn were sprayed with 2,4-D (amine salt) when corn was 6 inches in height. Rates applied were 1/4, 1/2, 3/4 and 1 pound of acid per acre. A portion of each plot was resprayed when corn was 12 inches in height using the same dosage as in the early spraying. Another series of plots were sprayed when corn was 12 inches in height using the same rates mentioned above. There was no significant difference in yield of corn between the various treatments when 1/4, 1/2 and 3/4 pounds of 2,4-D were applied, or when compared to checks. Two sprayings of one pound of 2,4-D per acre reduced yields. This reduction in yield was significant but only slightly greater than that brought about from one spraying at either the 6 or 12 inch stages of growth. All plots were cultivated twice and weeds removed by hoeing. (Contribution of Purdue University Agricultural Experiment Station, Lafayette, Indiana.)

Effect of spraying and cultivation on corn. Lee, Oliver C. Replicated plots of corn planted on a Crosby silt loam were treated as follows: One series was sprayed with 2,4-D at the rates of 3/4 pounds amine salt per acre when corn was 18 inches in height. No cultivation was applied. The average yield of corn was 85.4 bushels per acre as compared to 76.1 from the checks, a difference of 9.3 bushels between the treatments. Check plots were not sprayed or cultivated and as a result were very weedy. Another series of plots were cultivated when corn was 8 to 10 inches in height and sprayed with 3/4 pounds of 2,4-D per acre when corn was 24 inches tall. Yields of corn were 89.8 bushels or 13.7 bushels above the check. A third series was cultivated twice when corn was 8 and 24 inches in height. These plots produced an average yield of 94.3 bushels of corn per acre or 18.2 bushels over the check. Cultivation reduced the stand of grassy weeds. Spraying gave adequate control of broad leaf weeds. (Contribution of Purdue University Agricultural Experiment Station, Lafayette, Indiana.)

Cultivation and chemicals for weed control in corn. Shaw, W. C., W. H. Johnson, H. M. Gitlin, and C. J. Willard. This experiment consisted of four replications in a randomized block design. The plots consisted of six 40" rows of corn 270' long, of which the two center rows were harvested. The treatments and yields per acre were as follows: (1) No cultivation or chemicals applied, 15.8 bu.; (2) Three standard cultivations with sweep shovels, 27.0 bu.; (3) Same as (2) except scrapers (Russell shovels) next to row, 27.2 bu.; (4) Two standard cultivations with 2 lb. 2,4-D per acre at lay-by, 29.6 bu.; (5) Pre-emergence treatment with 2 lb. 2,4-D per acre and one cultivation when weeds

appeared, 26.5 bu.; (6) Pre-emergence treatment with 2 lb. 2,4-D per acre, 1/2 lb. 2,4-D post-emergence when weeds appeared, no cultivation, 27.3 bu. per acre; (7) Pre-emergence treatment with 2 lb. 2,4-D per acre, no post-emergence treatment and no cultivation, 24.1 bu. per acre. None of the differences, except with treatment (1) are significant. (Contribution of Ohio Agricultural Experiment Station, Columbus, Ohio)

Effect of 2,4-D as a post-emergence treatment on corn. Slife, F. W. and Fuelleman, R. F. Corn has been treated with 1/2, 1, and 1 1/2 pounds of 2,4-D acid in the amine form at several different stages of growth. When the corn was 2 inches tall it appeared to be particularly resistant at all rates, while at 6 inches the plants were slowed down in their rate of growth and exhibited a high degree of lodging. This was particularly true at the heaviest rate of 2,4-D. This difference in reaction to 2,4-D may have been caused by weather conditions. Corn sprayed at 10, 14 and 18 inches showed little reaction to 1/2 pound of 2,4-D acid in the amine form when applied over the top of the corn. The stalks were brittle at the 18-inch stage, but no breakage resulted from this because of mild weather following treatment. When precautions were taken to place the chemical down between the rows of corn, rather than over the top, little evidence of 2,4-D injury could be noted regardless of the stage of growth of the corn. (Contributions of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

PROJECT III-5 EFFECT OF HERBICIDES ON GROWING CROPS

Sorghums Investigation Leader: W. C. Elder

Only five abstracts were submitted from three investigators on sorghums. Since very little data on this subject have been carried over from former years, it is difficult to make definite recommendations from the meager information available at this time.

However, it is apparent from all reports that sorghum varieties and strains vary in their susceptibility to 2,4-D. Some varieties are able to withstand heavy dosages with little or no injury, while a few varieties are injured by light applications of 1/4 lb. per acre. As a whole, forage varieties seemed to be more resistant than the grain sorghums.

All investigators observed enlarged or deformed brace roots on treated plots, and when the injury was severe the permanent roots were affected. However, it appears there is less bending and lodging in sorghums than corn. Root damage was not always reflected in the grain yields.

Amine and ester formulations were used in the tests and the abstracts are not in complete agreement on their effects. One investigator finds no difference in reaction from the two formulations, another reports greater injury to plants when esters are used.

Small sorghum plants, up to 4 inches high, appear to be more susceptible to 2,4-D than larger plants when grain yields are considered. Greater root damage was noticeable on plants 10" to 20" high when treated. Evidently young plants are either killed outright or have the ability to recover. Treating during the heading stages of growth did not lower yields at the 1/2 lb. or lower rates. Heavy applications at any stage that reduced grain yields also delayed maturity.

Summary. From the submitted abstracts it is apparent that 1/2 lb. per acre of 2,4-D can be used on most varieties of sorghums without reduction of grain yields. Heavier rates may cause severe damage in all varieties. A few varieties may be affected by 1/4 lb. per acre rates. Considerable root deformity may be noticeable without grain or forage yield reduction. Plants under 4 inches high seem to be the most susceptible to injury.

PROJECT III-5 EFFECT OF HERBICIDES ON GROWING CROPS

Abstracts of Results of Cooperators

Sorghums

Morphological responses of sorghum varieties to 2,4-D. Phillips, W. M. Four grain and two forage varieties of sorghum were sprayed with an ester, and an amine at 3/4 pound 2,4-D acid per acre when the sorghum was 4 to 6 inches tall and a second series was sprayed one month later when the sorghum was about 24 inches tall. In addition Midland, a combine type, was sprayed with 1/4, 1/2 and 1 pound ester and amine at the same stages. Poor stands necessitated replanting and as a result the sorghum did not mature so that comparative yields could be determined. Soil moisture and growth conditions were near optimum at the time of the first spraying, however there was very little precipitation during the ensuing two months. Applications made when the sorghum was 4 inches tall resulted in deformed and enlarged brace roots and apparently arrested the development of the secondary root system. Many of the plants were poorly anchored and some subsequently died. The two forage varieties, Atlas and Ellis, were not affected so seriously as were the grain varieties, Early Kalo, Westland, Midland and Pink Kafir. There was little apparent difference in the reaction from the two chemicals, nor did the various rates used on Midland greatly change the results. The later date of application resulted in similar reactions and also injured the plants, but the damage was not so apparent as in the earlier application since the plants were rooted more securely. (Contributed by Bureau of Plant Industry, Soils and Agricultural Engineering, USDA, Hays, Kansas).

Response of 3 sorghum varieties to 2,4-D treatment. King, Jack. Three varieties of sorghum, Midland, Martin, and Coes, were grown in plots with six replications. Plots were sprayed 35 days after planting at the 4-5 leaf stage, with 1/2 and 1 1/2 pounds of the amine salt of 2,4-D using 40 gallons of water per acre. The following results were observed: (1) No reduction in floral fertility. (2) No significant differences as to grain yields in Martin or Coes but Midland treated with 1 1/2 pounds showed reduction significant from check at 5% level. (3) Midland and Martin showed no significant differences in total plant weight, but Coes treated with 1 1/2 pounds showed reduction from check significant at 1% level. (4) One and one-half pounds caused fasciation of brace roots on all varieties with fasciation of a lesser degree on Midland at 1/2 pound. (5) Time of heading slightly delayed by 1 1/2 pound application. (6) No differences in stalk diameter, leaf number, or plant height. (Contribution of the Dept. of Agronomy, College of Agriculture, Lincoln, Nebraska).

Observation of 183 varieties and strains of sorghum when treated with 2,4-D. King, Jack. One hundred eighty-three varieties and strains of sorghum were grown in single-row plots 33 feet long. Ten feet of each plot was sprayed 50 days after planting with 1/2 pound of the butyl ester of 2,4-D with 20 gallons of water per acre. No effects were observed on floral fertility or plant development except for usual fasciation of brace roots.

Two varieties of sorghum, Midland and Martin, were grown in single plots and sprayed 42, 49, and 56 days after planting with 1/2 and 1 1/2 pounds of amine salt of 2,4-D with 40 gallons of water per acre. Random branches of panicle of both treated and untreated plots were taken and counts on number of sterile and fertile florets were made. No difference in floral fertility was observed. (Contribution of the Dept. of Agronomy, College of Agriculture, Lincoln, Nebr.)

The effect of 2,4-D formulations on one sorghum variety when applied at five stages of growth. Elder, W. C. Dwarf kafir 44-14 was sprayed above the plants with 1/4, 1/2 and 1 lb. of amine and ester 2,4-D when the plants were 3", 10", 20", preboot and when 50% of the heads were out of the boot. All plots were hand-thinned to uniform stands and replicated four times. Weeds were removed with a hoe when small and normal cultivations made throughout the season. This variety of sorghum has shown considerable resistance to 2,4-D in all variety tests. Some of the young plants were completely killed at the 3" stage of growth with the 1 lb. rates. Injury to the root system was observed at the 10" and 20" stages of growth, especially by the 1 lb. ester type, however no injury to the roots was observed on the mature plants when treated at the 3" high, preboot and heading stages of growth. There was no bending or lodging in any plots of this combine type of grain sorghum. The only outstanding decrease in yield was in the 1 lb. rate of 2,4-D at the 3" stage of growth. This reduction of yield was due to poor stands as some plants had been destroyed by the treatment. There was slight reduction of yields by the 1 lb. ester treatment at the 20" and heading stages of growth. (Contribution of the Agronomy Department, College of Agriculture, Stillwater, Oklahoma).

Response of sorghum varieties to 2,4-D. Elder, W. C. and Frank Davies. Quadruplicate plots of Dwarf Kafir 44-14, Redlan, Wheatland, Plainsman, Martin's, Westland, Midland, Caprock, Club x Day, Bonita, Hegari C. I. 750, Darso Ok. 1, Kaferita C. I. 811 and Kaferita C. I. 812 were treated with 1/4, 1/2 and 1 lb. per acre of 2,4-D ester. The sorghums were 10" to 12" high when treated and growing conditions were very favorable. Observations for bending, lodging, and root injury were made during the growing season and at time of grain harvest plants were dug to determine the extent of root damage. Some injury occurred to the root system of all varieties at the 1 lb. level; however, the degree of injury differed in the varieties. Some varieties showed root injury at 1/4 lb. rate of treatment. Root injury above ground showed proliferation of the brace roots. When the severely injured plants were dug the permanent roots were all confined to a small area. These plants could be pushed over or pulled up very easily. Little bending or lodging occurred in the combine varieties. Some of the taller growing varieties spread across the row due to leaning and not bending near the ground. Wheatland and Westland grain yields were reduced by all treatments. The 1 lb. rate reduced yields for these two varieties from 50 to 75%. All other varieties did not show reduced grain yields when 1/4 and 1/2 lb. per acre was used and 7 varieties did not show reduction of yield for the 1 lb. treatment. (Contribution of the Agronomy Department, College of Agriculture, Stillwater, Oklahoma).

PROJECT III. EFFECTS OF HERBICIDES IN GROWING CROPS

Seedling and Established Grasses Investigation leader: Dayton L. Klingman

Summary

Reports of chemicals for weed control in grasses were limited in number. The reports indicate need for further critical studies to evaluate the usefulness of chemicals, both in seedling establishment and in established stands.

2,4-D can be used advantageously for broad-leaved weed control in seedling grasses if the weedy grasses are not a problem in the area. Under such conditions the spring-planted grasses gave marked responses in growth vigor the year following treatment with 2,4-D for weed control when compared to an untreated check or to a mowed check.

When 2,4-D was applied in the spring to late fall sown grasses for annual weed control at rates of one to two pounds per acre, the resulting stands were more uniform and more vigorous as a result of the removal of weeds (scattered plants of wild buckwheat not controlled).

Rates as high as one pound ester per acre were applied to seedling and newly established grasses for perennial weed control. Fall treatment of white cockle gave better control than spring treatment, but the fall treatment retarded the growth of grass slightly. Treatment either in fall or spring to well-established creeping red fescue gave no observable damage and good control of blue lettuce when applied at the bud stage at one pound ester per acre.

In areas infested with both broad-leaved weeds and weedy grasses, the use of 2,4-D was effective only in changing the type of weed competition. It is thought that the weedy grass competition was fully as detrimental to seedling grasses as were the broad-leaved weeds present on the untreated plots.

When six species of grasses were treated with one-half and one pound amine salt in greenhouse tests, injury resulting in reduction of stand occurred when the grasses were sprayed at emergence, the warm-season grasses included in the test being injured the most. All grasses at eight weeks following emergence were tolerant of the spray.

Twenty-eight day old Agrostis canina seedlings were given an extremely high rate of 2,4-D soil treatment in order to study anatomical responses. Ten days after treatment plants resembled young onions. Root systems were smaller, protuberances upon primary roots were observed, and leaves were seriously injured. The number of root initials was greatly increased both in the swollen base of the plant and along the primary root.

Alfalfa, two months after seeding, was sprayed with three ounces 2,4-D (ester) per acre. This treatment halted the heavy growth of Russian thistle, caused temporary curling of alfalfa seedlings, but these quickly recovered.

Questions as to toxicity of herbicides to livestock are frequently asked. Such information about dinitrophenol, pentachlorophenol, trichloroacetate, 2,4-D, and 2,4,5-T is reported. The grass-alfalfa mixture sprayed was grazed by horses, cattle, swine, and chickens. No injuries to the livestock were observed. Forage plants recovered from treatment with dinitro and P.C.P., alfalfa was destroyed by 2,4-D and 2,4,5-T, and all vegetation was destroyed by T.C.A.

Abstracts of Results of Cooperators

The use of 2,4-D for the control of white cockle. Carder, A. C. In 1948 treatment consisted of ploughing, preparing a seedbed, and seeding in early summer without nurse crop in one instance to brome and in another to creeping red fescue. Good stands of grass were obtained along with a heavy emergence of seedling cockle. When the cockle was in the 3- to 5-leaf stage one half of the area was treated with a butyl ester of 2,4-D at 16 ounces acid equivalent per acre. The remaining half of each grass plot was similarly treated when growth commenced the following spring. Results strongly favor the pre-winter application where a 93 and 90 per cent kill of cockle in brome and fescue were obtained, respectively; while where treatment was delayed till the following spring only a 73 per cent kill of the weed in brome and a 60 per cent kill in fescue occurred. The heavy dosage of 2,4-D when applied the seeding year retarded the growth of grass slightly. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

The effect of 2,4-D on pasture weeds. Friesen, H. A. The amine and ester formulations of 2,4-D were sprayed at the rates of 1, 1½, and 2 pounds of acid equivalent per acre in the spring of 1949 on new stands of bromegrass, crested wheatgrass, and western rye grass sown in the late fall of 1948. The seedling grasses had emerged some six weeks previous to the treatments and were heavily infested with flixweed (Sisymbrium sophia), Russian thistle (Salsola kali), stinkweed (Thlaspi arvense), lambsquarter (Chenopodium album), and scattered plants of wild buckwheat (Polygonum convolvulus).

Complete kills of all weeds but wild buckwheat resulted from each of the treatments. None of the treated grasses seemed to suffer any loss of vigor or morphological deformities as a result of the treatments. Indeed, the treated plots appeared to benefit from the removal of weeds since the stand was observed to be more uniform and the plants decidedly taller and more vigorous than the plants on the untreated and weed infested plots.

In addition to the above experiment, a small field of alfalfa was sprayed at the rate of three ounces of acid per acre, ester type, two months after it had been seeded in the spring of 1949. This treatment halted the heavy growth of Russian thistle, but caused only temporary curling of the alfalfa seedlings, which quickly recovered. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Studies on toxicity of herbicides to livestock grazing on pastures sprayed for weed control. Grigsby, B. H. and E. D. Farwell. Pasture lots consisting of a bromegrass-alfalfa mixture were sprayed with four times the manufacturer's maximum recommended dosage of dinitrophenol, P.C.P., T.C.A., 2,4-D amine, ester, and sodium salt, and 2,4,5-T ester. Stock on each lot consisted of horses, cattle, sheep, swine, and chickens. The sprays were applied to half of each lot, the stock grazed for one week, and then the remaining part of the lot was sprayed and grazing continued for another week. No injuries to any of the stock were observed nor was there any pronounced aversion to grazing the sprayed vegetation.

Forage plants recovered in the dinitro and P.C.P. lots, alfalfa was destroyed in the 2,4-D and 2,4,5-T lots, and all vegetation was destroyed in the T.C.A. lot. Alfalfa sprayed with T.C.A. made a vigorous regrowth, but at the end of six weeks began to die out and appeared to be completely killed. (Contribution from the Michigan Agricultural Experiment Station.)

Second year response of six warm-season and six cool-season grasses sprayed as seedling with 2,4-D for weed control. Klingman, D. L. The growth vigor and number of seed heads produced in 1949 was associated to a marked degree with the percentage weed control in the previous year. The increased vigor was less marked in such species as orchardgrass which tolerate considerable shading as compared to the less shade tolerant species such as Russian wild rye, crested wheat, or buffalograss. As an example of differences resulting, by May 10, 1949, crested wheatgrass which was treated with 3/4 pound ester May 25, 1948, had plants 14 inches tall compared to eight inches tall for plants in the weedy check (all debris of previous season removed in early April). The treated plants also had many more tillers per plant. Similar differences in vigor were observed in the abundance of inflorescence production in Russian wild rye, big bluestem, side-oats grama, blue grama, switchgrass, and sand lovegrass in that there were relatively few heads produced in the mowed or unmowed checks of 1948, but great numbers were produced in plots with weed control the previous year. Other species (with the exception of buffalo) produced considerable seed on the checks, but less seed than the plots having good weed control the previous year. Weedy grasses were not a problem in this experiment. A brief description of the treatments and first year results was given in Abstracts III-87 and III-89 of the North Central Weed Control Conference Research Report of 1948. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.)

Eradication of blue lettuce in wheat seeded down to creeping red fescue. Macdonald, D. J. The butyl ester of 2,4-D was applied at 4, 8, 12, and 16 ounces acid equivalent per acre to a well-established infestation of blue lettuce at bud and flower stages and in late fall. Weed growth was general in the plot area which was located in a wheat field seeded down to creeping red fescue. All three treatments were made under ideal weather conditions. Blue lettuce appears more susceptible to treatment with 2,4-D at the bud stage than at the flower stage. In the former stage it required eight ounces of acid to effect 93 per cent kill of top growth and to kill the root to six inches. In the latter stage the heaviest application effected only an 85 per cent kill of top growth, with slight root injury. No observations were made on the fall treatment since the weed at this time was wilted and in a state of dormancy. No damage to the seeded-down crop of creeping red fescue was noted from any of the treatments. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Effect of 2,4-D on seedling grasses under greenhouse conditions. Phillips, W. M. An amine of 2,4-D was applied at 750 and 1500 p.p.m. in sufficient volume to equal 1/2 and 1 pound per acre to six species of grass growing in a greenhouse. Grasses treated were buffalograss, blue grama, side-oats grama, bromegrass, western wheatgrass, and intermediate wheatgrass. Applications were made at full emergence and at 2, 4, and 8 weeks after emergence. All species were damaged when treated at emergence. The stand of the warm-season grasses, buffalo, blue grama, and side-oats grama was reduced more than 50 per cent, and many of the seedlings lacked chlorophyll. The three cool-season grasses were not damaged appreciably except when treated at emergence. The warm-season grasses were tolerant to the dosages used eight weeks after emergence, but reduction of stand occurred from the second and third treatments. Damage to the grasses was greater from the higher rate of application. (Contributed by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

Anatomical changes of bentgrass (Agrostis canina) from soil treatment with 2,4-D acid. Watson, D. P. Twenty-five pots (five 28-day-old seedlings per pot) were flooded with .005 gm. of the sodium salt of 2,4-dichlorophenoxyacetic acid in 30 ml. of water (per 190 gms. of moist soil). Ten days after the time of treatment, increased growth at the base of the plant had caused some of the leaves to bend unnaturally. The plants resembled young onions. A large number of small protuberances had appeared on many of the primary roots. The treated plants had much smaller root systems than those that remained untreated. Permanent microscope preparations showed that about 5 mm. above the solid stem at the base of the plant leaves from treated plants were seriously injured. After ten days the veins had been pushed out of position by typical chloroplast-free replacement cells. The swollen base of the plant contained many root initials, the development of which had been stimulated by the chemical. Root initials had been increased in number along the primary root, but then elongation had been inhibited, reducing the over-all size of the root system. (With seven illustrations.) (Contribution of Department of Horticulture, Michigan State College, East Lansing, Michigan.)

Project III. Effect of Herbicides in Growing Crops.

Sugar Beets — Invertigation leader: E. A. Helgeson

Summary

Pre-emergence Studies: As has been noted in previous studies environmental factors have undoubtedly affected results from the several stations. This summary covers reports from workers in several Canadian Stations, Michigan and North Dakota who participated the past summer in a uniform experiment set up at a Regional Conference held in Fargo last spring.

NaTCA at 10 and 20 lb. rates gave fair to good weed control without serious injury to beets. At higher rates beets were severely injured (Anderson, Grigsby, Swanson, et al). According to Grigsby and Swanson et al, dinitros in water or oil reduced beet stands without controlling weeds. EH #1 and 2 gave fair weed control at Fargo with some reduction in beet stand and had no effect on either beets or weeds in Manitoba. Two cooperators reported good weed control with 2,4-D with severe reduction in beet stands. In one instance increased yields were reported. IPC affected neither weeds nor beets at Fargo and Manitoba. Michigan reported good weed control in water or oil with no effect on beet stand with aqueous sprays and 60% reduction in an oil carrier. Aero cyanate was ineffective at Fargo and in Manitoba. Chlorosol A at rates to 80 lbs./A affected neither beets nor weeds in Fargo trials. Diesel oil reduced beet stands at Fargo but not in Manitoba but gave no weed control at either location. Polybor controlled weeds fairly well in Fargo and Manitoba trials with some reduction in beet stand and vigor. PCP was fairly effective against weeds at Fargo and in Michigan, stands and beet vigor were affected adversely at both stations. Manitoba found this chemical ineffective. Fargo and Manitoba trials showed NaPCP did not control weeds with a reduced beet stand evident at the former station. Sexsmith of Alberta reported 80% weed control, a reduced beet stand but an increased yield of beets. Fargo trials yielded fair grass control with some beet injury with XP39A and Manitoba found XP40A ineffective. Sulfasan affected neither beets nor weeds at Fargo while Alberta reported increased beet yields with some leaf distortion.

Post-emergence Studies: Sulfasan, $ZnSO_4$, EH #2 and Chlorosol A affected neither beets nor weeds as indicated in single reports. Grigsby reported some weed control from NaTCA at rates over 10 lbs. with slight to severe beet injury as rates increased; Fargo results similar. NaCl controlled some broadleaf weeds in Michigan and Manitoba trials with little injury up to 400 lbs. but considerable beet injury at 600 lbs. Fargo results were negative in both respects. Copper chloride and nitrate gave poor weed control with severe beet injury at Fargo and Manitoba. In Michigan, $CuNo_3$ controlled broadleaf weeds, injured beets severely; the latter recovered. KCl at 200 lbs. controlled weeds without beet injury, at 400 lbs. beets were injured according to Grigsby. Slight to fair weed control with injury to beets was reported for aerocyanate by Fargo and Manitoba. Manitoba reported good to fair control of pigweed and false ragweed by Polybor with slight injury to beets.

Abstracts of Results of Cooperators

Pre-emergence

Pre-emergence chemical treatments for weed control with sugar beets. Andersen, E. T. and Shradoldt, C. A. Treatments, chemicals, and concentrations as recommended for trial in 1949 by the Regional conference on weed control in sugar beets held at the Agricultural Experiment Station, Fargo, N. D. in March, 1949 were tested, insofar as it was possible to obtain the materials. The following pre-emergence treatments showed no measurable control of weeds, which were mostly pigweed (Amaranthus retroflexus), stinkweed (Thlaspi arvense), and purslane (Portulaca oleracea), or any significant effect on the beets: Experimental Herbicide No. 1 and No. 2 (Carbide and Carbon Chemical Corporation), Shell 130, XP-40A (Green Cross), Sodium PCP, PCP, Aero Cyanate, Diesel Oil No. 2, and IPC. Sodium TCA applied at rates of 10, 20, 30 and 40 pounds per acre showed considerable weed control throughout the summer. Weed counts for the treated plots ranged from 8 to 25 compared with 37 to 49 for the checks. Emergence and growth of sugar beets was also weakened and reduced, but a satisfactory stand of sugar beets was obtained, and growth appeared normal by the end of the season with all but the 40 lbs. treatment which reduced the size of the roots. Polybor applied at 320 pounds per acre resulted in a reduced stand of beets and a mild distortion and chlorosis of the beet foliage. At 640 pounds per acre good control of all weeds was obtained and the beets showed some chlorosis and reduced vigor. This reduction in vigor was continuous throughout the growing season. (Contri. of the Plant Science Division, the University of Manitoba, Winnipeg.)

Post-emergence

Post-emergence chemical treatments for the control of weeds in sugar beets. Andersen, E. T. and Shradoldt, C. A. Chemicals, procedures, and treatments as recommended for trial in 1949 by the Regional conference on weed control in sugar beets held at the Agri. Expt. Sta. Fargo, N. D., March, 1949, were tested insofar as it was possible to obtain the necessary chemicals. Sodium TCA and Experimental Herbicide No. 2 (Carbide and Carbon Chemical Corporation) had no apparent effect on either weeds or beets. Sodium chloride applied at both 200 and 400 lbs. rates per acre gave promising results. Complete and immediate killing of red-root pigweed (Amaranthus retroflexus) and stinkweed (Thlaspi arvense) resulted. Purslane (Portulaca oleracea) and lambs quarters (Chenopodium album) although checked were not killed. Slight stunting during the early part of the summer was apparent in the beets, otherwise no differences from the checks were in evidence. The heavy treatments were not noticeably more effective than the lighter ones. Aero cyanate, Cupric nitrate and Cupric Chloride were very destructive to the beets and gave various degrees of weed control. Zinc Sulphate was ineffective in controlling weeds. Polybor was applied at 160 and 320 lbs. per acre. Only slight scorching and dwarfing of the beets resulted but control of red-root pigweed was nearly complete. False ragweed (Iva xanthifolia) was much stunted but survived. (Contri. of the Plant Science Division, The University of Manitoba, Winnipeg.)

Pre-emergence

Herbicides for Pre-emergence Use on Sugar Beets. B. H. Grigsby. In a series of 17 herbicides applied as pre-emergence treatments to sugar beets on the day of seeding and, on other plots, four days after seeding no chemical was found to give satisfactory weed control without severe reduction of beet stand TCA, dinitrophenol, PCP, IPC and diesel fuel show some promise, however, of being useful for weed control purposes, provided that the seeding rate is such that some loss of beets can be tolerated. TCA at 10 and 20 lbs./A applied at seeding did not seriously affect beet emergence but higher rates and ester application kill beets as well as weeds. Foxtail grass was suppressed at all rates but barnyard grass was not killed.

Dinitrophenol, in water reduced beet stands 25% at 1 lb./A and the same amount in diesel fuel caused a 60% reduction IPC, emulsifiable form at rates up to 20 lbs./A did not reduce the stand of beets and gave 89% control of all weeds. In oil, however, these amounts caused stand reductions up to 60%. PCP, at 4 and 8 lbs./A caused stand reduction up to 50% and a similar degree of weed control 16 lbs. gave no better weed control and up to 90% stand reduction.

All forms of 2,4-D used in these trials were extremely toxic to beets and were not effective in the control of weeds. (Contri. from Michigan Agricultural Exp. Sta. and B.P.I.S. & A.E.)

Post-emergence

Selective Sprays for Sugar Beets. B. H. Grigsby. TCA, NaCl, KCl, Copper salts, Zinc sulfate, Chlorosal A and two experimental formulations of 2,4-D were applied at various rates on sugar beets. Of these, only NaCl, KCl and Copper nitrate gave weed control without excessive injury to beets. NaCl sprays, at 200 and 400 lbs./A, were satisfactory in plots where grasses were not abundant. Ragweed and smartweed, when young, were readily killed at either rate of application. 600 lbs. NaCl, however, killed the beet plants. KCl gave a satisfactory kill at 100 and 200 lbs/A, while 400 lbs. killed beets that had developed 2 to 4 true leaves. TCA and Chlorosal A at rates less than 10 lbs./A did not control weeds. Greater rates of application caused the beets to become flattened, yellow in color and delayed growth for 2-3 weeks.

Copper nitrate at 10 and 20 lbs./A killed broadleaved weeds and caused severe injury to young beets. The beets recovered, however, and by September were as vigorous as any other beets in the field. Zinc sulfate had no effect on beets or weeds when used at 20 lbs./A. The 2,4-D formulations killed beets more quickly than they killed weeds. (Contribution from the Michigan Agricultural Experiment Station and B.P.I.S. & A.E.)

Pre-emergence

Pre-emergence Chemical Weed Control in Sugar Beets at Fargo-Moorhead, 1949. Swanson, C. R., E. A. Helgeson, R. Konzak and L. M. Stahler. NaTCA at 10 to 40 lbs./A reduced stand and beet vigor at higher rates; good weed control in all tests. Sinox W in oil or water at 1, 1½ and 2 lbs./A gave progressive stand reduction and no weed control. EH #1 and 2 at 1, 2, 4 and 2, 4 and 8 lbs./A reduced beet stands slightly with fair to good weed control. IPN 472 at 1 and 2 lbs./A, marked stand reduction some weed control. IPC at 5, 10, 20 lbs., Sulfasan at 4, 8, 12 lbs., Aero Cyanate

at 10, 20, 30 lbs., Chlorosol A at 20, 40, 80 lbs. did not reduce beet stands nor control weeds. Diesel oil at 50 and 100 gal. reduced beet stands, no weed control. Polybor at 320 and 640 lbs. slight to severe stand reduction, good weed control. PCP at 4, 8, and 32 lbs. and NaPCP at 16, 24 and 32 lbs.Both gave progressive stand reductions and only PCP gave broadleaf weeds fair control. XP39A at 1, 3 and 5 qts. reduced beet stands, controlled grass weeds fairly well at higher rates but not broadleaf weeds. Chemicals applied at seeding and 4 days later. (Contrib. U. S. Dept. Agri. Div. Cereal Crops and Dis. BPISAE and N. D. Agri. Exp. Sta.)

Post-emergence

Post-emergence chemical weed control in sugar beets at Fargo-Moorhead, 1949. Swanson, C. R., L. A. Holgeson, R. Konzak and L. M. Stahler. NaMA at 2, 4, 6 lbs./A retarded grasses, little affect on broadleaf plants. NaCl at 200 and 400 lbs. affected neither weeds nor beets. Copper chloride and nitrate injured beets, no weed control, later weeds depressed. $ZnSO_4$ was ineffective at 10, 20 and 30 lbs. XP39A at 2 and 4 qts. retarded beet growth but not weeds. Sulfasan at 1, 2, 4 lbs. and Chlorosol A at 10, 20 and 40 lbs. burned beet leaves slightly with no weed control. Aero cyanate at 5, 10, and 15 lbs. injured beets severely at higher rates with no weed control. All above treatments applied when beets were 29 days old. (Contri. U. S. Dept. Agr. BPISAE, Div. Cereal Crops and Dis and N. D. Agr. Exp. Sta.)

Pre-emergence weed control in sugar beets. Soxsmith, J. J. Duplicate plots of sugar beets were treated six days after seeding with Santobrite (Sodium pentachlorophenate) at 20 and 40 lb. per acre, Sulfasan (Xanthogen disulphide) at 5 and 10 lb. per acre, Cyanamid (calcium cyanamide - powdered) at 100 and 200 lb. per acre, and triethanolamine 2, 4-D and butyl ester 2,4-D each at 3/4 and 1½ lb. per acre. The Cyanamid was applied in the dry form, and all other treatments were in water at the approximate rate of 300 gal. per acre (Sulfasan emulsified with diesel fuel - 3 gal. per acre). Weed control of 80% or over was obtained from treatments with Santobrite 40 lb., and amine and ester 2,4-D at 1½ lb. Relatively severe reduction of unthinned beet stands resulted from Santobrite 40 lb. and all 2,4-D treatments. Varying degrees of malformation of early leaves were caused by above mentioned treatments as well as by Sulfasan at both rates used. Significantly higher yields resulted from Santobrite 40 lb., Sulfasan 5 lb., and all 2,4-D treatments. However, there was a significant negative correlation between number of beets per plot and beet yields, and it seems probable that stand reductions due to treatments were primarily responsible for the decrease in numbers of beets harvested and the increases in yield. No significant differences in sugar content were obtained. Treatments which gave over 80% weed control and reduced stands of unthinned beets would materially reduce thinning and weeding costs. (Contribution of Dominion Experimental Station, Lethbridge, Alberta).

Project III. Effects of Herbicides in Growing Crops.

Fall-planted wheat, oats, and barley Investigation leader: W. M. Phillips

Summary

Sixteen abstracts, many with supporting tabular data, were received from six locations. Two of these were concerned with controlling weeds in winter wheat and three with the effect of 2,4-D on wheat quality factors. The remainder dealt with experiments carried out to determine the effect of 2,4-D and 2,4,5-T on fall-planted cereal crops. As in the past, there was not complete agreement on all factors.

Five investigators or teams of investigators made applications of 2,4-D on wheat in the fall. All reported abnormal growth and significant decreases in yield from fall applications. Shaw and Willard reported a significant yield reduction with as little as 1/4 pound amine when applied November 23. Woestemeyer reported from 49 to 73 per cent reductions in yields on six different varieties treated in the fall. In Illinois Slife, Scott and Fuelleman found 1/8 pound 2,4-D applied in the fall caused sterile spikelets and other deformities. In the 1947-48 season Elder successfully treated wheat in the fall, but in 1949 he noted reduction in yield. He mentioned that treatments were made on very small wheat in the fall of 1948.

There was considerably less agreement from results of spring treatments. Elder, Klingman, and Woestemeyer found no appreciable differences in yields from various dates of spring treatment. Slife and Fuelleman reported some yield reduction as the result of an April 8 treatment but not from a May 11 application except at 2 2/3 pounds 2,4-D. Shaw and Willard found rates from 1/4 to 4 pounds detrimental when applied May 12 (late joint), May 23 (headed) and June 2 (blooming). In general the esters caused greater damage. Treatments made earlier and later showed less effect. Yields of wheat reported by Phillips were extremely low and variable, but he found a highly significant difference in yields in favor of the boot stage over the early jointing stage.

Klingman's work indicated that, of the rates applied, only the 2 pound rate of ester gave a significant reduction in yield. Phillips found no differences in chemicals or rates. Klingman, Phillips, and Woestemeyer reported little difference between the effect of 2,4-D and 2,4,5-T on wheat.

Shaw and Willard found significant differences in the reaction of four varieties and two selections of wheat to 2,4-D. Other investigators noted some trends, but indicated additional work is necessary. Phillips found different varieties react differently at various stages of growth.

Slife, Scott and Fuelleman indicated that fall applications gave more satisfactory control of wild garlic in wheat than did spring treatments. Rates necessary for control caused some damage to the wheat. Woestemeyer reported that at corresponding rates the esters were more effective than the sodium salt for controlling annual weeds in wheat.

Judging from the abstracts received in 1949 and in previous years, it appears that under certain conditions wheat may be injured at almost any stage of growth if 2,4-D is used at rates necessary for weed control. In many cases the reduction in yield may not cause so great a loss as the weeds which were present.

Several investigators reported that field applications of 2,4-D had no apparent effect on the germination of the harvested winter wheat.

Elder indicated both fall planted oats and barley were more seriously injured by fall applications of 2,4-D than was wheat.

Klingman, Shaw and Willard, and Shellenberger and Phillips reported the effect of 2,4-D on the protein content of winter wheat. In general, a decrease in wheat yield was accompanied by an increase in protein. Shellenberger and Phillips found no significant differences in total ash content or in milling or baking quality of wheat from 2,4-D treated plots.

Abstracts of Results of Cooperators

Fall-planted wheat, oats, and barley

Effect of 3 formulations of 2,4-D on 8 varieties of fall-planted small grains when treated at 4 stages of growth. Elder, W. C. Spray applications of 3/4 lb. per acre of butyl ester, triethanolamine and sodium salt were made on Pawnee, Comanche, Wichita, Triumph and Clarkan wheat; Tenkow barley; Traveler and Wintok oats in the early fall tiller, spring tiller, boot and dough stages of growth. Field technique used was according to the uniform plan outlined in 1948 for Project III-2, except that all varieties were randomized within each replication. The fall treatment was made when the plants were very small, the other treatments were made under very favorable weather conditions for good growth. Data were collected on the estimated vegetative injury for the fall treatment and on the grain yields for all treatments. The fall application on young plants, with the ester formulation, caused onion type growth of the leaves of all varieties. The salts caused considerable onion leaf to many of the varieties. It appeared that oats were more severely injured, followed by barley, with the wheat showing the least injury. Analysis for grain yield showed significant differences for the time of treatment and formulation used. All varieties responded very much alike for all the treatments. The differences in yields were caused by the reduced yields for the fall applications for all formulations, and especially for the ester type. Significant changes of yield did not occur for any of the formulations when applied in spring tiller, boot or dough stages of growth. (Contributed by Agronomy Department of the Oklahoma A. & M. College Experiment Station.)

Average response of 22 varieties of winter wheat to fall and spring spraying of 2,4-D. Klingman, Dayton L. and Shafer, Neal E. Small portions of drilled plots of 22 winter wheat varieties were sprayed with one pound of ester 2,4-D in order to determine differential response of varieties to treatment. Varieties were sprayed October 14, 1948 when the wheat was in the three-leaf stage and first tillers just beginning to show. The spring treatment was applied April 29, 1949 when the wheat was seven to nine inches tall. Growth was vigorous, although the top soil was becoming dry. Because of the high rate of winter killing, the data are somewhat variable and differential response will not be reported until the experiment is repeated. However, the average response to fall and spring spraying was markedly different in that the yield for the fall spraying averaged 7.8 bushels per acre for all the varieties compared to 14.1 bushels per acre for spraying in the spring, and 16.3 bushels per acre for the same varieties in unsprayed, hand-weeded plots. It is recognized that the rate of treatment was somewhat excessive and may exaggerate the differential injury of fall versus spring spraying. (Contribution of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A., and the Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska.)

Effects of 2,4-D and 2,4,5-T on Pawnee winter wheat applied at 11 rates on 4 different stages of growth in 1949. Klingman, Dayton L. Weed-free Pawnee wheat was sprayed at Lincoln, Nebraska in 1949 with 2,4-D at rates varying from 0 to 2 lbs. and 2,4,5-T ester at 1 pound in 40 gallons per acre on 4 stages of growth--late jointing (16" tall), boot (22" to 28" tall), late boot (29" to 31" tall, heads emerging from last sheath), and flowering (1/3 to 1/2 of anthers dehisced). Growth was extremely vigorous throughout the season. Heavy leaf rust and considerable lodging prevented the wheat from developing high yields. Average yields of 24 replications, including all dates, were as follows: check (untreated, weed-free), 31.2 bus.; ester of 2,4-D, 1/8 lb. per acre, 29.7 bus.; 1/4 lb., 31.4 bus.; 1/2 lb., 32.0 bus.; 1/2 lb. (in 4 qts. of oil emulsified in water), 31.8 bus.; 3/4 lb., 30.1 bus.; 1 lb., 30.7 bus.; and 2 lbs., 26.0 bus.; amine salt, 1/2 lb., 31.1 bus., and 1 lb., 31.2 bus.; ester of 2,4,5-T, 1 lb., 30.6 bus. Standard error of the mean difference of the above yields is 1.0 bushels. Differences between rates exceeded the 1% level of significance, and differences between dates were not statistically significant. The above treatments in 1948 gave statistically significant decreases compared to the check in 7 of 9 treatments. The treatments in 1949 had only the 2 pound ester as significantly different (other conditions reduced yields of all plots). Other data taken has not been analyzed statistically, but differences are small in number of kernels per head, number of spikelets per head, heads per foot of row, weight per kernel, test weight, height, date of heading, and per cent germination. The number of kernels per head again appears to be most closely related to yield. Differences in germination were very small, ranging from 87.2 to 89.2 per cent with the check germinating 89.1 per cent. (Contribution of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.).

Effect of various rates and dates of application of 2,4-D and 2,4,5-T on the yield of winter wheat. Phillips, W. M. Randomized nursery plots of weed free Comanche wheat were sprayed in triplicate with an ester, an amine, and a sodium salt of 2,4-D and an ester of 2,4,5-T at 0, 1/8, 1/4, 1/2 and 1 pound acid per acre. Treatments were applied when the wheat was in the early jointing stage and at the mid-boot stage. Heavy precipitation in June resulted in conditions favorable for the development of a number of diseases and insects. No differential in susceptibility to injury due to treatment was noted. Wheat yields were greatly reduced from earlier estimates, lodging was 100 per cent in many plots and the quality of the grain was very poor. Statistical analysis of the yields failed to show significant differences between any of the chemicals or rates. There was a highly significant difference between the two stages of growth with the later stage giving the higher yield. Germination varied from 95 per cent to 98 per cent indicating no effect from the various treatments. Determination of the average number of kernels per head, and weight per 100 kernels are being made, but results are not available at the time of writing. (Contributed by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S. D.A., Hays, Kansas.)

Varietal reaction of winter wheat to 2,4-D. Phillips, W. M. Randomized nursery plots of seven varieties of wheat were sprayed in triplicate at the early jointing and late boot stages with 3/4 pound 2,4-D acid per acre as an ester, an amine and a sodium salt. The varieties used were: Comanche, Early Triumph, Wichita, Blue Jacket, Pawnee, Moking, and C.I. 12133 (an unnamed selection). Yields were generally low due to adverse weather conditions, diseases, and insect damage. Statistical analysis showed no significant difference between the stages of growth or between chemicals. Average of all no treatment plots was the same as the average of all treated plots. A significant interaction was found between stages and varieties. Two of the varieties, Early Triumph and Moking, yielded significantly higher when treated in the boot stage than when treated earlier. Although the differences were not significant, the other varieties, except Comanche, gave higher yields as a result

of the early jointing treatment; thus neither stage gave consistently superior yields. The experiment indicates that there may be a varietal differentiation at various stage of growth. Germination was not effected by treatment. (Contributed by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A., Hays, Kansas.)

Effect of 2,4-D on Thorne wheat at 9 stages of growth. Shaw, W. C. and Willard, C. J. The butyl ester and triethanolamine salt of 2,4-D were applied to Thorne winter wheat on November 5 (3-leaf stage), November 23 (5-leaf stage), March 28 (tillering), April 20 (fully tillered), April 30 (jointing), May 12 (late joint), May 23 (headed), June 2 (blooming), and June 12 (milk stage) at 0, 1/4, 1/2, 1, 2, and 4 pounds per acre on each date, in a randomized split plot design, 4 replications, plots 7' x 25', 480 plots in all. The yield of wheat was not reduced by any treatment less than 4 pounds per acre on March 28, April 20, April 30 and June 12. The greatest reduction in yield came on May 12, but the loss from November 23 treatments averaged almost as much. Even as little as 1/4 pound of the amine salt on November 23 damaged the plants and reduced the yield significantly. All rates were injurious on May 12, May 23 and June 2, and all except 1/4 pound on November 5. The butyl ester gave slightly higher yields than the amine salt on March 28, apparently because of better control of the relatively few weeds in the wheat, and very much lower yields at corresponding rates on November 23, May 12, May 23, and June 2--the dates when both formulations reduced the yield. These results are in accord with previous recommendations for spring treatment, but the damage November 23 is unusually severe. (Contributed by Ohio Agricultural Experiment Station.)

Varietal differences in the effect of 2,4-D on wheat. Shaw, W. C. and Willard, C. J. Four important varieties and two new selections of wheat were treated with an ester of 2,4-D on November 5 (three leaves), April 20 (fully tillered), and May 4 (late joint stage), at 0, 1/2, 1, 2, and 4 pounds per acre, in a randomized, split plot design with 3 replications. There were significant differences in the reactions of the different varieties. In order of increasing injury they ranked TN1016-4, much the least injured, Thorne and Trumbull, then Butler and TN1223, with Vigo the most injured. In general the greatest differences were exhibited at rates beyond the 1/4 to 1/2 pound per acre generally recommended for weed control. The protein content of these samples was determined by the Federal Soft Wheat Laboratory at Wooster, and here again the varieties did not respond alike, though there was a definite tendency for the protein content to be increased when the yield was considerably decreased. TN1016-4, which was hardly affected by 2,4-D except by 2 and 4 pounds at the late joint stage, also showed no change in protein content except at those two rates and stages. Vigo gave the largest increases, over 3 per cent, while Butler gave an increase of 1.3 per cent per 4 pounds at late joint stage, and less than 1 per cent at any other stage or rate, though its yields were greatly reduced. (Contributed by Ohio Agricultural Experiment Station.)

Effect of 2,4-D on winter wheat. Slife, F. W. and Fuelleman, R. F. Eight varieties of winter wheat were treated once in the fall and twice in the spring with 2,4-D in the amine form. Rates used were 1/3, 2/3 and 1 1/3 pounds of acid in the fall and 1/3, 2/3, 1 1/3 and 2 2/3 pounds of acid in the spring. Varieties included in this test were Newcaster, Fulhio, Prairie, Wisconsin 2, Royal, Indiana Red Wave, Vigo, and Fultz. These varieties were planted on October 8, 1948, and fall treated on November 29, 1948. This fall spraying reduced the yield of all varieties even with the lowest rate used. The lower yield could be accounted for by few plants, shorter spikes, sterile spikelets, and a reduction in plant height. Application of 2,4-D on April 8, 1949 caused some reduction in yield of all varieties particularly at the heavier rates, but not as severe as the fall spraying. The May 11 treatment did not materially affect the wheat except with the 2 2/3 pound application. No varietal differences could be observed from this test at any of the three dates of

application. The fall sprayed plots were a deeper green color the following spring. This might indicate increased nitrogen content, but the reduced leaf area of sprayed plants as well as the fewer number of plants in the sprayed area could account for this. Plant samples were taken from all plots for nitrogen analysis. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Effect of 2,4-D and 2,4,5-T as selective herbicides on Pawnee winter wheat. Woestemeyer, V. W. Triplicate plots of Pawnee wheat, each consisting of two 14-foot drill rows, were sprayed with amine, sodium salt and ester types of 2,4-D, and the ester type of 2,4,5-T. Rates per acre were 1/8 to 1 pound 2,4-D acid, and 3/4 and 1 pound 2,4,5-T acid. Wheat was drilled October 12 and emerged about October 20. Stages of spraying were fall tiller (Nov. 18), spring full tiller (April 23), and nearly fully headed (May 26). Moisture conditions were favorable and wheat was growing rapidly at each stage of spraying. The average yield of untreated checks was 10.3 bushels per acre. Spraying at the spring stages showed no definite effect on yield from treatments of 2,4-D or 2,4,5-T. However, the yield of fall treated plots decreased considerably as the rate of application increased, with low yields of four bushels per acre from 1 pound of sodium salt, 4.4 and 5.4 bushels respectively from 3/4 pound of amine and ester 2,4-D, and 6.7 bushels from one pound of 2,4,5-T. Fall sprayed plants showed no response until jointing began, but by harvest it was evident that the plants had been stunted considerably, especially by the heavier rates, and heads were distorted because of difficulty in emerging from the boot. The awns from many heads were still being held by the boot at harvest time. This stunting and distortion was observed in fall sprayed plots only. (Contribution of Kansas Agricultural Experiment Station.)

Effect of 2,4-D and 2,4,5-T on the yield of Pawnee winter wheat when applied in the fully tillered stage. Woestemeyer, V. W. Pawnee wheat was sprayed in the fully tillered stage with the ester formulations of 2,4-D and 2,4,5-T separately and in combinations, the total acid equivalent being three tenths of a pound per acre in all cases. The experiment was conducted on triplicate plots. The seven treatments ranged from .30 to .00 pounds 2,4-D per acre at .05 pound intervals, combined with .00 to .30 pounds 2,4,5-T per acre respectively at .05 pound intervals. No effects were observed on the plants from any treatment. There were only minor variations in the average yields of the different treatments, ranging from a low yield of 7.4 bushels per acre on the .20 pound 2,4-D-.10 pound 2,4,5-T plots to a high yield of 8.9 bushels per acre on the .25 pound 2,4-D-.05 pound 2,4,5-T plots. Yields were 8.4 and 8.5 bushels per acre on the .30 pound 2,4-D-.0 2,4,5-T plots and .0 2,4-D-.30 pound 2,4,5-T plots respectively. (Contribution of Kansas Agricultural Experiment Station.)

Effect of 2,4-D on six varieties of winter wheat. Woestemeyer, V. W. Sodium salt, amine and ester formulations of 2,4-D were sprayed on six varieties of winter wheat at the rate of 3/4 pound acid per acre. Varieties included were Early Triumph, Wichita, Pawnee, Comanche and Minter hard winter wheats, and Moking, a soft winter wheat. Stages of application were fall tiller (Nov. 16), spring full tiller (April 28), early heading (May 26), and soft dough (June 13). All fall sprayed plots showed considerable reduction in height after jointing began, and many heads were distorted, because of difficulty in emerging from the boot. At harvest time many of the heads of bearded varieties were still curved with the beards held fast in the boot. All varieties had some heads that could not emerge and remained undeveloped, and all showed occasional twisted stems and reduced root development. With the exception of Minter, which showed slightly less damage than the other five varieties, and Moking which is beardless and had less curved heads, there was no distinct difference in varietal response observed in the field. Yields of all varieties were greatly reduced from all fall treatments. At that stage, the ester caused greater

reductions than sodium salt in all varieties, with the amine usually intermediate. Minter, Wichita and Early Triumph were similarly affected, with average reductions in yield of 49, 51, and 54 per cent respectively. Pawnee, Comanche and Moking were more severely affected, with average reductions in yield of 69, 71, and 73 per cent respectively. (Contribution of Kansas Agricultural Experiment Station.)

Controlling wild garlic (Allium vineale) in winter wheat with the ester form of 2,4-D. Slife, F. W., Scott, W. O. and Fuelleman, R. F. Wild garlic has been effectively controlled by using 1 pound of acid in the ester form applied in late November. No aerial or underground bulblets were formed in these plots. Rates lower than 1 pound of acid gave only partial control. Winter wheat was severely injured by fall application of 2,4-D. As low as 1/8 pound of acid per acre produced sterile spikelets, shorter spikes, and reduced stem heights. Early spring applications (April 5) were only partially effective against garlic and did not eliminate the formation of underground bulblet. Rates of 1 pound of acid on April 5, reduced aerial bulblet formation by 70 per cent. Wheat was injured at this rate, but not as severely as by fall applications. Applications on April 29, had little effect on garlic, even when 2 1/3 pounds of acid per acre was used. Soap added to the water carrier or an oil-water emulsion as a carrier for the 2,4-D gave no better control of garlic than the ordinary water carrier. Bulblets, both aerial and underground, were taken from all plots, except plots treated in the fall with 1 pound or more of acid per acre. Germination tests indicate that 2,4-D has not had any depressing effect on the germination of garlic bulblets. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Controlling annual weeds in winter wheat with 2,4-D. Woestemeyer, V. W. Wild buckwheat, coreopsis, lamb's-quarters, treacle mustard and false flax growing in winter wheat were sprayed at the fully tillered stage of the wheat (April 18). All weeds were seedlings except mustard which was still in the winter rosette stage. Sodium salt and ester types of 2,4-D were used at 1/8, 1/4, 1/2, 3/4 and 1 pound per acre. False flax was controlled satisfactorily with 1/8 pound ester and 1/4 pound sodium salt. Lamb's-quarters and coreopsis required 1/4 pound ester and 1/2 pound sodium salt, while treacle mustard needed 1/4 pound ester and 3/4 pound sodium salt. Wild buckwheat was the most resistant requiring 1/2 pound ester and 3/4 pound salt for satisfactory control. In all cases the ester achieved a slightly higher degree of control than the salt at rates given, but both types were satisfactory at these rates. Considerably heavier rates were necessary in all cases to obtain complete kills. One pound sodium salt did not give complete kills of any of the weeds and 1 pound ester did not kill all wild buckwheat. Rates given above prevented or retarded weed growth enough to prevent interference with the crop. Rates of 1/2 pound per acre and up of either type of 2,4-D resulted in some pre-emergence control of wild buckwheat and lamb's-quarters. Emergence of the other weeds was nearly complete on the date of spraying. (Contribution of Kansas Agricultural Experiment Station.)

Effect of 2,4-D and 2,4,5-T on protein content and protein per acre of Pawnee winter wheat grown in 1948. Klingman, Dayton L. Protein analysis was made of the wheat grain from plots reported in Abstract III-57 of the North Central Weed Control Conference Research Report of 1948. The average protein content and protein per acre for the various treatments on all four dates were as follows: check, 13.4% (392.3 pounds per acre); ester of 2,4-D, 1/8 pound, 13.6% (372.9 pounds per acre), 1/4 pound, 13.5% (374.2 pounds per acre), 1/2 pound, 13.7% (369.9 pounds per acre), 3/4 pound, 13.6% (337.8 pounds per acre), 1 pound, 13.9% (331.9 pounds per acre), and 2 pounds, 14.8% (296.6 pounds per acre); amine salt of 2,4-D, 1/2 pound, 13.3% (368.7 pounds per acre), and 1 pound, 13.4% (364.2 pounds per acre); and ester of 2,4,5-T, 1 pound, 14.1% (340.9 pounds per acre). Data in parenthesis above are pounds of protein per acre. The standard error of the mean difference for protein

content in per cent is 0.5%. Differences between rates and between dates in percentage protein content were beyond the 1% level of significance with the increasing rates of 2,4-D treatment tending to give higher percentage protein. However, when percentage protein is multiplied by the yield produced, the result (in parenthesis above) gives the opposite trend, i.e., with increasing rates of 2,4-D treatment the yield of protein per acre is decreased. The reduction in yield in bushels per acre was greater than the relative increase in percentage protein content of the grain. (Contribution of the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

Effect of 2,4-D on the protein content of wheat. Shaw, W. C. and Willard, C. J. Protein was determined in samples of wheat harvested after being treated with the butyl ester and the triethanolamine salt of 2,4-D at 0, 1/4, 1/2, 1, 2, and 4 pounds per acre on each of 10 dates, 4 replications of each treatment, 480 samples in all. The average of all the checks (80 samples) was 10.4% protein, with a maximum range of 9.7 to 11.9%. Only 4 samples were 11% or higher--76 samples within the range 9.7 to 10.9. The samples treated with 2,4-D gave increased percentages of protein up to 16.0% as an average of 4 plots, and to 17.3% on single plots. The increase in protein was almost exactly correlated with the damage to the crop and the decrease in yield--in fact, increased protein content was as sensitive an indicator of damage as reduced yield. In no case was the total protein per acre significantly increased by 2,4-D treatment. We are indebted to the Federal Soft Wheat Laboratory at Wooster, Ohio for making these protein determinations. (Contributed by the Ohio Agricultural Experiment Station.)

Effect of 2,4-D on quality factors of hard red winter wheat. Shellenberger, J. A. and Phillips, W. M. Wheat samples from the experiment described in abstract III-54 of the North Central Weed Control Conference Research Committee Report of 1948 were analyzed for protein and ash. The mineral content of the wheat was not effected significantly by the treatments. Applications made during the early heading stage gave a significant increase in per cent protein. None of the other dates affected the protein content significantly. When total protein (protein x yield) was considered there was no significant difference between treatments or dates of application. Applications of 2,4-D did not affect appreciably the milling or baking quality of the wheat. (Contributed by Hard Winter Wheat Quality Laboratory, Manhattan, Kansas, and Division of Cereal Crops & Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Hays, Kansas.)

Project III. Effects of Herbicides in Growing Crops.

Flax

Summary

R. G. Robinson

Abstracts on chemical weed control in flax were received from Iowa, Kansas, Minnesota, Montana, South Dakota, Manitoba, Saskatchewan, and Alberta.

The esters of 2,4-D were, in general, more injurious to flax than the amine salts at equal dosages. Sodium salts of 2,4-D were considerably less injurious to flax than the amines, but several investigators reported relatively unsatisfactory weed control with sodium salts. Two investigators reported measurable differences in the reaction of flax to different amines.

The margin of safety between dosages of 2,4-D that injure flax and dosages that give effective weed control is narrow according to Zahnley and McCall. Most investigators reported visible responses from nearly all dosages but these symptoms were not always reflected in yield of seed. Under weed-free conditions at recommended growth stages, decreased yields of flaxseed were reported by several investigators at dosages of 2 oz. of ester [illegible]. On the other hand, there were also reports of no injury to yield with 4 oz. of ester or amine under weed-free conditions. Under weedy conditions, the effect of dosage on yield was difficult to distinguish from the effect of weed control.

Time of application was described in number of days after emergence, in height of flax plants, and/or in stage of growth of the flax. In general, flax was reported susceptible in the cotyledon stage, moderately resistant from the early rosette or first leaf stage till about two weeks before full bloom, very susceptible in bud and bloom stages, and resistant when bolls had formed.

Varietal differences in response to 2,4-D were reported in eight of nine abstracts dealing with this subject, however these differences did not always result in significant differences in seed yields.

The relative resistance of varieties changed between different times of application according to Davidson and Foster. Coupland, studying six varieties, reported that those most susceptible as ranked by delay in maturity were most resistant when ranked according to decrease in seed yield.

Delayed flowering and maturity on plots sprayed with 2,4-D were commonly reported. At recommended stages and dosages, these delays were, in general, not more than one to three days.

Morphological symptoms of 2,4-D were reported by several investigators. These symptoms included twisted and fasciated stems, increased branching, fused leaves, destruction of the terminal bud, and sterile bolls. Some of the seed from flax sprayed in early bud, according to Warden, failed to develop cotyledons while the seed coats developed to almost normal size. Such seed coat development did not occur in hand emasculated flowers.

In general, seed from sprayed flax, especially at high dosages, showed a decreasing capacity to germinate after various periods of storage according to Heggeness and LeTourneau.

The oil content of seed from sprayed flax was about the same as that of unsprayed flax according to Friesen and Chubb-MacKey. Friesen also reported that the iodine number of the oil from sprayed flax was slightly less in one of two years while Chubb and MacKey found that the iodine number was not affected. Heggeness and LeTourneau found that the oil content of seed from flax sprayed at bud was less than that of unsprayed flax.

Working with fibre flax, Chubb and MacKey reported decreased yield and quality of line fibre but no decrease in seed yield at dosages of 4 oz.

MCP (Methoxone, Agroxone) was less injurious to flax than amine or ester of 2,4-D at equal dosages and controlled wild mustard in Minnesota and Frenchweed in Saskatchewan at 4 oz. It was ineffective on Russian thistle, wild buckwheat, and pigweed at 6 oz. according to Pavlychenko.

Zahnley and McCall reported that Aerocyanate, 2%, killed all weeds including grasses and was injurious to flax, however lower dosages might give better results.

IPC, TCA, and Chlorosol-A gave poor results in the few tests reported.

(Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 685, Misc. Jour. Series, Minnesota Agricultural Experiment Station.)

Project III. Effects of Herbicides in Growing Crops.

Abstracts of Results of Cooperators

Flax

Effect of various herbicides on flax. Bakke, A. L. and D. W. Staniforth. The Dakota variety of flax was treated with various concentrations of an ester, an amine, and a sodium salt of 2,4-D. In the case of the ester formulation there was no significant decrease in yield until a concentration of 1/2 lb. per acre was reached. One-half lb. of a triethylamine salt reduced the yield but the sodium salt at 1/2 lb. per acre did not give a significant decrease. The micronized acid at 1/2 lb. per acre produced a significant decrease. Dow Selective, Sinox 3 pints per acre, sodium pentachlorophenate 1/2 percent, and T.C.A. 4 lbs. per acre in 100 gallons of water were not significantly different as far as yields from the control. With an increase in the concentration of the 2,4-D there was a decrease in the number of weeds. Six different varieties of flax, growing in a nursery with no weed competition were treated with 1/8 and 1/4 lbs. of Weed-No-More per acre. Victory, B5128, Redwing, Dakota, and Minerva showed a significant decrease in yield with the 1/4 lb. while with the 1/8 lb. there was a significant decrease in yield for the varieties B5128, Minerva, and Redwing. (Contribution of the Iowa Agricultural Experiment Station, Ames, Iowa.)

The selective control of wild oats in flax by IPC, TCA and Chlorosol-A. Carder, A. C. Four rates of IPC and TCA, viz., 2, 4, 8, 16 pounds acid equivalent per acre were applied to Redwing flax seeded in land heavily infested with wild oats (Avena fatua). A pre-emergent treatment was made when the flax sprouts were approximately 1/2" long and the first wild oats emerging in addition to three post-emergent treatments one, two, and three weeks after the emergence of the flax. With the last treatment Chlorosol-A also was used at the above rates. A uniform stand of flax thickly inter-grown with wild oats occurred. All rates and dates of TCA and Chlorosol-A produced no effect on either the wild oats or on the flax. IPC, on the other hand, showed selectivity, in that when applied as a pre-emergence spray at 16 pounds per acre it removed over 80 percent of the flax from the wild oats. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Comparable potency of 2,4-D formulations. Carder, A. C. Three formulations, viz., the monohydrate sodium salt, the triethanolamine salt, and the butyl ester of 2,4-D were applied to stinkweed (Thlaspi arvense) in Victory oats at 2, 4, 8, 12, and 16 ounces 2,4-D acid equivalent per acre. The same formulations were applied at 2, 4, 8, and 12 ounces to lamb's quarters (Chenopodium album) in Redwing flax. In either trial treatment was made when the weed and crop were considered at the proper stage for 2,4-D application. Extreme differences in potency of the three formulations occurred. In respect to stinkweed, the ester, amine, and sodium salt compare in their lethal ability as 2: 8: 16 ounces acid equivalent per acre, respectively; while with lamb's quarters the ratio was 2: 4: 12. Weed kill was based on visual estimates made three weeks after treatment. Based on yield and kernel weight, oats proved sensitive to 4 ounces ester and 16 ounces amine, while flax indicated reduced yield and kernel weight when 4 ounces of ester and 12 of amine were applied. A delay of 5 to 8 days in maturity of flax was caused by 2 ounces of ester, 4 of amine, and 12 of sodium salt. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Effects of 2,4-D sprays on fibre flax. Chubb, W. O. and E. H. MacKey. In the first test, Liral Dominion, Liral Prince Toba and Royal flax were sprayed with 4 oz. alkanolamine at the 2 to 3 inch, 4 to 6 inch and early bud stages. In the second, the same varieties were sprayed with 4 oz. of alkanolamine, isopropyl ester and sodium salt when 4 to 6 inches tall. In the last two, Liral Dominion flax was sprayed with 0, 2, 4, and 8 oz. alkanolamine when 4 to 6 inches tall in 1948 and soon after the five true leaf stage in 1949. In the first three tests the flax was grown on weed free and in the last on weedy plots. In 1948 the flax treated at the 4 to 6 inch stage yielded less line and total fibre than that treated at the 2 to 3 inch stage. There were no differences in seed yields between stages. There were no differences in fibre or seed yields between formulations. In all four tests the 4 oz. treatment decreased the yields and quality of line fibre. The yield and quality of line fibre and yield of total fibre from Liral Dominion were reduced by the 8 oz. amine treatment. Seed yields were not reduced by any of the treatments. For seed from the rates tests oil content, oil iodine number, 1000 kernel weight, bushel weight and germination were not affected up to 8 oz. of amine in 1948. For seed from the rates tests in 1949, yields were not reduced and quality (germination not tested) was not affected. (Contributed by Dominion Experimental Farms Service, Fibre Division, Portage la Prairie, Man.)

Differential response of six varieties of flax to 2,4-D. Coupland, R. T. Four blocks of flax, each consisting of 30 plots of 7 rod rows, were seeded on silty clay loam soil in the dark-brown soil zone at Saskatoon on June 6, 1949. Each block was divided into 5 main plots in which the treatments were randomized. Six randomized sub-plots contained as many varieties of flax. Triethanolamine was applied to main plots at 4 and 8 ounces per acre in 10 gallons of water on June 29, when the flax averaged 4 inches in height, and on July 30, when the flax was in late bud and early blossom. No effect of treatment was observed, after the immediate wilting had passed until maturity was approaching. In order of increasing resistance to delayed maturity the varieties were rated as Royal, Dakota, Redwing, Arrow, Victory, and Rocket. This delay was greatest in the second treatment at the higher rate, where averages for different varieties ranged from 3 to 9 days. No effect on mature height resulted in any variety. Yield data show that the order of the varieties from the most resistant to most susceptible are Royal, Redwing, Arrow, Dakota, Rocket and Victory. Varietal yields expressed in relation to controls, averaged from 65 to 94 percent with the first treatment at 4 ounces and from 96 to 121 percent at 8 ounces. With the second treatment the corresponding values were 68 to 105 and 18 to 42 percent. Increases above the checks may have been due to effect in weed control before hoeing. These data tend to show a negative correlation between effect of 2,4-D on yield and effect of the herbicide in delaying maturity. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Effect of three formulations of 2,4-D on Royal flax in three stages of growth. Coupland, R. T. Four blocks of Royal flax, each consisting of 45 plots of 7 rod rows, were seeded on June 2, 1949 on silty clay loam soil in the dark-brown soil zone at Saskatoon. Each block was divided into 3 sections for treatment at different dates. Treatments on 15 plots within each section were completely randomized and consisted of butyl ester, triethanolamine and sodium salt at 0, 2, 4, 8, and 12 oz. of acid per acre in 10 gallons of water. Dates of treatment were June 17 when the flax was 2 inches in height, July 5 when it averaged 5 inches in height, & July 29 when it was in bud and early flower. All plots were kept free of weeds. Maturity was delayed by 1 to 2 days by applications of all formulations at 4 oz. per acre and higher in the first 2 stages of growth. In the bud treatment, maturity was delayed by an average of 9, 6, & 3 days by ester, amine, & sodium salt, respectively. Yields

were increased by all applications in the first 2 stages of growth, presumably because of damage to the few weeds which were present before hoeing. Increases were highest in the amine treatments, presumably because of less damage to flax than with ester. Yields were significantly higher with treatment during the second stage of growth than with that during the first stage (117 percent compared to 106 percent of the untreated plots). Reduction in yield resulting from treatment in bud and early flower was significant, being greatest in the case of ester and least with sodium salt & increasing with the higher rates of treatment. Ester at 12 oz. yielded 30 percent of the control, while the 2, 4, & 8 oz. treatments of sodium salt yielded 86 percent. Another experiment showed this variety to be the most resistant to 2,4-D of any grown in this area. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Response of flax and rape to sodium trichloroacetate. Coupland, R. T. Thirty plots of Royal flax, 30 of Argentine rape and 3 plots of Polish rape were sown on May 10, 1949 in silty clay loam in the dark-brown soil zone at Saskatoon. Each plot consisted of 7 rod rows spaced 6 inches apart. Emergence of flax and rape was delayed until May 25 and June 8, respectively, because of drought. Duplicate treatments were made on Royal flax and Argentine rape with sodium trichloroacetate at 2, 4, 8, and 12 pounds of active ingredient per acre in 10 gallons of water. Polish rape was treated with 8 pounds per acre in unreplicated plots. Treatments were made on June 21 when the flax was 3 to 4 inches high and the rape was 2 to 3 inches high, on July 7 when the flax and Argentine rape were in the rapidly advancing vegetative stage and the Polish rape was flowering, and were repeated on both dates. No effect of the chemical was observed on any of the crops with respect to vegetative or reproductive development. No yields were taken because of insufficient replication. Under the conditions of this experiment concentrations of sodium trichloroacetate up to 12 pounds of active ingredient per acre, even when applied twice during vegetative stages of development, produced no detrimental effects on Royal flax and Argentine rape. Polish rape showed no response to the chemical when it was applied at 8 pounds per acre, even when the crop was in blossom. Since experiments with Avena fatua and Setaria viridis indicate no damage to these weedy grasses at the same rates, the application of greater concentrations of sodium trichloroacetate might be feasible in an attempt to control the latter in flax and rape. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Effect of 2,4-D as a selective herbicide on linseed flax. Davidson, J. G. During 1949 five varieties of linseed flax, namely, Royal, Redwing, Dakota, Victory, and Rocket were treated at six stages of growth with applications of four ounces acid equivalent of an amine salt of 2,4-D. The stages were the four leaf, five to seven leaf or 3 inches, five inches, seven inches, ten inches, and twelve inches high, at which stage the flax was in early flower. Based on yield Dakota was the most resistant to 2,4-D at the early stage followed by Victory and then Redwing. At the flowering stage, Redwing showed the least injury. All the varieties, especially Rocket, showed reduced yields in the treated plots, but they were less injured at the four leaf stage than at later stages. Maturity was delayed one to seven days but in Dakota and Redwing maximum delay was only two days. Straw was shorter in the treated plots than in the weeded checks. Weeds were mainly frenchweed (Thlaspi arvense) and redroot pigweed (Amaranthus retroflexus). These were controlled in plots treated at the first three stages but not satisfactorily in those at the later stages although they were freer of weeds than the unweeded checks. (Contribution of the Dominion Experimental Farm, Indian Head, Sask.)

Effect of 2,4-D and methoxone on flax with and without weeds. Dunham, R. S. and R. G. Robinson. Koto and Cyrstal varieties were sprayed when 3-6 inches tall at dosages of 0.5, 1.0, 1.5, and 2.0 oz. of butyl ester 2,4-D, 2, 3, 4, and 8 oz. of amine 2,4-D, and 4, 6, 8, and 16 oz. of sodium salt MCP per acre in 22 gals. of water. One set of plots for each variety was kept weed-free by cultivation. In a second set, wild mustard was sown in the row with the flax, but the space between rows was cultivated. Plots consisted of 3 rod rows and were replicated 4 times. On weed-free plots the trend in seed yield was downward for both varieties with increasing dosages of each herbicide. On the flax with weeds plots yields were increased by 0.5 and 1 oz. of ester, 2 and 3 oz. of amine, and 4 and 6 oz. of MCP. The relative susceptibility of Crystal was apparent in straw yields on weed-free plots which were lower than Koto for corresponding dosages and in number of fused leaves which was larger for Crystal. Straw yields of flax with weeds were either increased or remained about the same with all dosages except 16 oz. of MCP. A reduction in mustard was accompanied by an increase in yield of flax seed and an increase in yield of grass weeds up to certain levels of dosage. Larger dosages resulted in lower flax yields. The ratio of equivalent amounts of each herbicide appeared to be 1-4-7 of ester, amine, and MCP respectively for reduction in seed yield, 1-2-4 for straw yield, and 3-6-8 for killing of mustard. MCP was especially effective in killing mustard. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 684, Misc. Jour. Series, Minn. Agri. Exp. Station.)

Response of flax varieties to 2,4-D and methoxone. Dunham, R. S. and R. G. Robinson. Rod row plots of Redwing, Koto, Dakota, Sheyenne, Royal, Victory, Minn. No. 218, B5128, Crystal, and Minerva were sprayed with 1.3 oz. of 2,4-D butyl ester, 4 oz. of 2,4-D triethanolamine salt, and 8 oz. of MCP, sodium salt per acre when 3-4 inches tall. Plots were replicated 8 times. At these dosages the average seed yields of all varieties were lower on the sprayed plots than on the unsprayed but the differences were not significant. Reductions amounted to 0.6, 0.4, and 0.8 bu. for the ester, amine, and MCP respectively. MCP plots showed more stem twisting, less leaf fusing, and more delay in bloom than amine or ester. Maximum delay was 3 days. The response of varieties to these dosages was not significantly different but Minerva, Victory, B5128, & Sheyenne yielded relatively less seed as compared to check plots than the other varieties. As an average of all varieties, straw yields were not reduced and there was no differential varietal response to the herbicides at these dosages. Minerva, Crystal, B5128, and Minn. No. 218 had more fused leaves on the sprayed plots than the other varieties. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 680, Misc. Jour. Series, Minn. Agri. Exp. Sta.)

Effect of 2,4-D on flax. Ficht, Jos. It has been possible to control the growth of Russian thistle and more susceptible weeds in flax by the use of amine and ester formulations of 2,4-D. The sodium salt formulation has been practically non-effective in the control of Russian thistle in this area. The most practical rates of application have been 2 to 4 oz. of 2,4-D acid per acre. While these applications were effective in 1948 and 1949 under fairly severe drought conditions, the treatment did not prove of practical value in 1949. Drought conditions were such that even with one effective treatment the growth of flax was not sufficient to prevent a re-infestation of weeds which prevented harvesting a very light crop. Observations of treated areas during the past 3 years have indicated certain definite changes in the relative resistance of flax seedlings to 2,4-D as growth takes place. In the cotyledon stage, immediately after emergence, seedlings are susceptible to killing by heavy applications (16 oz. per acre). In the early rosette stage, before the internodes have elongated, seedlings appear to survive heavy treatments fairly well.

Susceptibility is again noted when the lower two or three internodes have elongated. Resistance to complete killing appears to develop gradually after this stage. (Contribution of the Dominion Experimental Station, Swift Current, Saskatchewan, Canada.)

The effect of 2,4-D on flax when applied at different growth stages. Foster, J. Roe. Sodium, amine and ester formulations of 2,4-D were applied to Royal flax at rates of 2, 4, and 8 oz. of basic acid per acre. Spraying was done on 66 of the 85 days between May 23rd and August 16th. Only two days were missed in June. There was a definite decrease in yields when the ester was applied later than 4 weeks after emergence. The 4 oz. rates of amine increased the yields when applied between the 11th day of emergence and flowering time, after which yields were depressed. Sodium salts had little effect on yield, except at the 8 oz. rate when applied after June 30. These applications reduced the yields. With the ester, spraying before the 14th day after emergence caused little delay in flowering. Spraying between the 14th and 38th days delayed heading 5 or 6 days, and when applied just before flowering, the 8 oz. rate delayed flowering up to 20 days. The amine delayed flowering 1 to 5 days at all dates of spraying to flowering time, the least delay being from the 7th to 14th day after emergence. Sodium salt delayed flowering 1 to 4 days on all dates up to flowering, with the least delay occurring when sprayed between the 1st and 13th day after emergence. When sprayed in the blossom stage, the crop was set back and bloomed the second time 2 or 3 weeks later. Yields were sharply reduced by all formulations when spraying was done at flowering time. This reduction in yield was due to sterile bolls. Some lodging occurred when spraying was done after flowering, but the crop righted itself 5 or 6 days later. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Sask. Canada.)

Effect of 2,4-D on different varieties of flax. Foster, J. Roe. An ester formulation of 2,4-D was applied at the rate of 8 oz. of acid per acre to 4 varieties of flax at 2 stages of growth. Applications were made on June 14 and 28 when the flax had been emerged 2 and 4 weeks, respectively. When sprayed on June 14, Dakota was the most resistant and Royal the least resistant varieties from the standpoints of yield and delayed maturity, with Bison and Liral Dominion in intermediate positions. When sprayed on June 28, the Liral Dominion and Bison were more resistant than Dakota or Royal. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

Effect of 2,4-D on linseed flax. Friesen, H. A. Three formulations of 2, 4-D were sprayed on Dakota flax at the following rates of acid per acre viz: ester and amine at 4 and 12 oz., and sodium salt at 12 oz. The treatments were made at 15 stages of crop growth beginning 3 days prior to emergence and ending in the boll stage. All plots had ample moisture for growth and were kept weed free by hoeing. At stage 1, prior to emergence, only the 12 oz. rate of ester had a depressing effect on the yield. At stages 2 and 3, (the cotyledon to 1st true leaf stages) all plots treated with amine and ester at 12 oz. were completely killed. All other treatments resulted in highly significant yield reductions. At stages 4 (6 true leaves) only the amine at 4 oz. and sodium salt at 12 oz. were equal to the check in vigor and yield. All treatments made at stages 5, 6, 7, 8, 9, and 10, that is, from the 6 true leaf stage to the pre-bud stage, affected the vigor and morphological characteristics. However, only the amine and ester at the 12 oz. rate significantly depressed the yield. At stages 11, 12, and 13 (bud and flowering stages) all but the sodium salt treatment resulted in highly significant yield reductions. The treatments tended to cause profuse branching, lodging, delayed maturity and sterility. None of the treatments significantly affected the crop yield, when applied in the boll stage. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effect of 2,4-D on linseed flax varieties. Friesen, H. A. Three formulations of 2,4-D were sprayed at four rates viz: 2, 4, 6, and 8 ozs. of acid per acre on each of four varieties of oil flax, namely Royal, Redwing, Dakota, and Victory. The treatments were made three weeks after emergence of the flax plots. Growing conditions were fair in the spring and early summer. All plots were kept weed free by hoeing. All varieties showed a marked tolerance to each of the treatments used at this particular stage of growth. Temporary stem curling and retarded growth and vigor resulted only where the ester at 6 and 8 ozs. were used. The effects of these two ester treatments were most pronounced and observed for the longest period of time on the variety Dakota. The varieties Victory and Royal, while less affected than Dakota, reacted in essentially the same manner to each of the treatments. Redwing showed slightly less effect and recovered somewhat more rapidly from the treatments than did either Royal or Victory. The effect of the treatments was too slight to result in significant yield differences between varieties. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effect of 2,4-D on the quality of spring wheat and linseed flax. Friesen, H. A. In 1947 three formulations of 2,4-D at rates of 4, 8, and 16 ozs. of acid per acre were sprayed on Rescue wheat and Royal flax. The wheat was sprayed at four stages of growth vis: 1) pre-emergence, 2) 3 leaf, 3) shot blade, and 4) late flowering stages, while the flax was sprayed when 4 inches tall. Growing conditions were extremely unfavorable throughout the season. Mr. A. G. O. Whiteside, Cereal Division, Ottawa, made the analysis on wheat. His comments were, "Our data would not appear to indicate that the 2,4-D applied at the rates used in this experiment effected the milling and baking qualities of the wheat". The National Research Laboratory tests showed that the oil content and iodine values of the treated flax was essentially equal to that of untreated flax. Samples of wheat and flax treated with 2,4-D in 1949 in the same manner as in 1947, again showed little or no effect on the milling and baking qualities of the wheat. The oil content of the flax was not effected but the iodine value for nearly all treated samples was very slightly lower than it was for the untreated samples. Growing conditions in 1948 were essentially as unfavorable as they were in 1947. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effects of four amine salts of 2,4-D on flax. Heggeness, H. G. and Duane LeTourneau. Four amine sales of 2,4-D (diethylamine, triethylamine, isopropylamine, and a blend of ethylamine and triethylamine) supplied by Sharples Chemicals Inc. were applied to one hundreth acre plots of Redwing flax at rates of 0, 1/4, 1/2, and 1 pound per acre in 1948. Injury to the terminal bud and increased branching were the most pronounced morphological effects, being particularly noticeable on the isopropylamine plots. Delayed maturity and reduced yield were also evident at the higher applications. Chemical analyses were made on the seed from these plots. Heavier applic tions at the bud stage decreased oil content up to 5%. The free fatty acid content of the oil was typically increased whereas the protein nitrogen analyses gave no consistent response. Results of weed counts coupled with yield data and chemical analyses indicated that the diethylamine salt gave the best results. The isopropylamine salt was considered least desirable. (Contribution from the Division of Plant Pathology and Botany, Minnesota Agricultural Experiment Station.)

Viability of seed from Redwing flax treated with amine salts of 2,4-D. Heggeness, H. G. and Duane LeTourneau. Redwing flax plots were treated in the pre-bud and bud stages with four amine salts of 2,4-D (triethylamine, diethylamine, isopropylamine, and a blend of ethylamine and triethylamine supplied by Sharples

Chemicals Inc.) at rates of 0, 1/4, 1/2, and 1 pound per acre. Results indicated that seed from flax sprayed in the pre-bud stage is not adversely affected from the standpoint of viability. Seed from flax sprayed in the bud stage showed decreased viability in the following cases: 1 pound rate of isopropylamine, 1/4 pound rate of isopropylamine, and 1 pound rate of diethylamine. These values were statistically significant. In general, seed from sprayed flax showed a decreasing capacity to germinate when stored for various periods of time. This effect was also evident when some of these seeds were planted in the field after 8 or 9 months of storage. That is, fewer successful seedlings were established, and in some cases the seedlings showed decreased vitality. (Contribution from the Division of Plant Pathology and Botany, Minnesota Agricultural Experiment Station.)

Treatment of soil with 2,4-D before planting flax. Heggeness, H. G. and Herbert G. Johnson. Four different soils were brought in from the field in October 1948. Their characteristics were as follows:

Soil Type	pH	% Org. Matter	% Colloid	No. Microorg. per gram fungi	Bacteria	Soil Class
Peat	6.2	17.5	8.8	10,400	360,000	Silt loam
Mineral	7.0	5.3	12.0	5,000	460,000	Silt loam
Mineral	7.5	4.2	14.0	17,300	475,000	Silt clay loam
Clay	8.4	1.2	17.0	6,500	275,000	Sandy clay

The effect of the pretreatment of these soils with an amine salt of 2,4-D was studied. Three variables of four items each were used, i.e. 4 soils, 4 concentrations of herbicide, and 4 times of application of herbicide. Crystal flax was used as a test plant. The plants in soil with relatively high organic matter, low pH, and low colloid content gave the best emergence and growth. In general, emergence and growth were less at higher 2,4-D concentrations. This effect was considerably less in the case of the high organic soil. The greater the time elapse between application of 2,4-D and planting, the less the injurious effect of the 2,4-D. Applications did not affect the type or numbers of soil microorganisms. The 2,4-D appeared to diffuse uniformly through the soil. (Contribution from the Division of Plant Pathology and Botany, Minnesota Agricultural Experiment Station.)

The effect of treating wild oats (Avena fatua) seeded with flax with TCA at four rates of application and TCA - 2,4-D mixture at two rates of application at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized 4 foot by 8 foot plots of flax were treated in triplicate with sodium trichloroacetate at 6, 12, 24, and 48 lbs. of the acid per acre and a mixture of TCA 12 lbs. per acre plus triethanolamine salt of 2,4-D 1/4 lb. per acre and TCA 24 lbs. plus 2,4-D 1/4 lb. per acre. Half of the number of plots were seeded to wild oats (Avena fatua) and other annual weeds at the same time the flax was seeded. An extremely dry period prevailed immediately after seeding preventing germination and stunting the germinated plants both flax and weeds. Treatment was made June 6, 1949 when the flax was 8 inches tall and the wild oats and other weeds were 2 to 3 inches high. Weed counts were made on June 28, 1949. Results indicate at no rate of the TCA alone was there any material control of wild oats and other weeds. When 2,4-D was mixed with TCA the annual broadleaf weeds such as lambs quarters (Chenopodium album) and Kochia (Kochia scoparia) were eliminated nearly 100 percent. An analysis of variance of the yields indicated a significant difference in treatments. An L.S.D. at the 1% level showed all treatments in the wild oats plots except TCA at 6 lbs. per acre to have reduced the yields significantly. TCA at 48 lbs. on the wild oats free flax lowered the yield

significantly at the 1% level. TCA at 12 lbs.plus 2,4-D 1/4 lb. lowered the yield significantly at the 5% level. Results indicate TCA will reduce flax yields without controlling the grassy type weeds. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

The effects of 2,4-D on flax when applied at various stages of growth. Olson, P. J. Butyl ester was applied as a spray to flax at the rate of 5 oz. pure acid per acre on each of 23 dates starting 4 days after seeding and continuing at approximately 3 day intervals. Rather severe damage was done during a period starting with the 12th application when the plants were about 7 inches tall and continuing through the 20th application which was made when the plants were about 14 days past bloom. The peak of damage seemed to be reached at about 6 and 10 days past bloom at which stage treatment produced a very sharp reduction in yield. (9.5 and 8.0 bushels per acre against 21.8 for the check; necessary difference of 3.92 bushels). The visible reaction of the plants during this period consisted of severe dwarfing from the earlier treatments, killing back of terminal growth and flower buds (which was partially offset by production of new growth) and delay in maturity reaching a maximum of about 10 days. Bolls under some of the treatments produced only partially developed seeds. Little or no damage was done at the stages prior to and following those just described. Only the pre-emergence spray and the last two treatments failed to produce some visible effect on the crop. (Division of Plant Science, The University of Manitoba, Winnipeg.)

Response of varieties of flax to 2,4-D. Olson, P. J. and Saul Zalik. Amine and ester were applied to each of three varieties of flax, Dakota, Royal, and Rocket on each of two dates, June 7 and June 29 at each of two rates, 3 oz. and 6 oz. pure acid per acre. The flax was sown April 29. The first treatment was applied when the plants were about 7" tall and the second 5 days after full bloom in the case of Dakota, 2 days before full bloom in the case of Royal and Rocket. Severe damage was done to all varieties by the ester treatment at both rates at the second date of application and by the higher rate of amine at the second date. Dakota suffered the greatest damage. Even the low rate of amine reduced the yield of this variety greatly. At the first date, ester damaged this variety considerably at the 6 oz. rate. No damage of consequence was done by either rate of amine at this date. (Contribution from the Division of Plant Science, The University of Manitoba.)

Response of spring grain crops and flax treated 24 days after emergence with different systemic herbicides. Pavlychenko, Thomas K. Spring wheat, oats, barley, rye, and flax were treated at 2 oz./a rates with ACP 638, 472 (both 2,4-D acid), ACP 646, 649, 675, 648 (various formulations of 2,4-D) Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D) and Agroxone (2 methyl 4 chlorophenoxyacetic acid). Quadruplicate treatments were made on all crops grown on a silt-clay loam soil at Saskatoon, Sask. The principal weeds were stinkweed (Thlaspi arvense), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus), red-root pigweed (Amaranthus retroflexus) and some other amaranths. Extremely heavy infestation of grasshoppers in June and July has caused some distortion to grain yields, particularly wheat and barley. Results: At 2 oz./a. rate all the chemicals used were sufficiently tolerant to the crops, including flax, to cause no serious retardation in their development. Of them all, Agroxone was the most tolerant to crops. It was effective on young stinkweed but failed to control older plants and was altogether ineffective on Russian thistle, buckwheat and the amaranthus sp. ACP 649 was the most effective on the weeds but it also depressed crops, particularly flax and

oats. Of the other chemicals, Weedar 64 in oil was extremely severe on weeds but it also depressed the grain crops and flax. ACP 648 showed consistently a high selectivity for Russian thistle. ACP 638 and ACP 472, acid of 2,4-D, showed considerable tolerance to crops, but they were somewhat weaker on weeds than either Weedone Concentrate 48 or Weedar 64. Weedar 64 in oil, ACP 675 and ACP 646 were all hard on flax in the order stated. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Response of spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 4 oz./a. rates, 1949. Pavlychenko, Thomas K. Quadruplicate plots of spring wheat, oats, barley, rye and flax were treated with ACP 638, ACP 472 (both acid of 2,4-D), Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), Agroxone (2 methyl 4 chlorophenoxyacetic acid), ACP 646, 648, 649, and 675 (all 2,4-D non-commercial formulations) at 4 oz./a. rates. The prevailing weeds were: stinkweed (Thlaspi arvense), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus), red-root pigweed (Amaranthus retroflexus) and some other amaranths. The soil was silt-clay loam. In June and July a heavy infestation of grasshoppers caused some damage, particularly to wheat and barley plots, and distorted the yield results. Results: At 4 oz./a. rates Weedar 64 in oil, ACP 649 and 675 noticeably depressed flax, wheat and oats, were easier on barley and rye. Agroxone was very tolerant to all crops but ineffective on weeds excepting young stinkweed. ACP 648 depressed Russian thistle as much as ACP 649 or more, yet was quite tolerant on crops. ACP 638 and 472 were both easy on crops but also less effective on weeds than either Weedone Concentrate 48 or Weedar 64 in water. ACP 646 did not harm grain crops, was much harder on flax, but did not give any outstanding results with weeds. ACP 649 caused some blasting in oats. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Response of spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 6 oz./a. rates, 1949. Pavlychenko, Thomas K. Quadruplicate plots of spring wheat, oats, barley, rye and flax, all with alternating checks, were treated with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), and ACP 638, 472 (acid of 2,4-D), ACP 646, 649, 675 and 648 (all 2,4-D non-commercial formulations) at 6 oz./a. rate. Prevailing weeds were stinkweed (Thlaspi arvense), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus), red-root pigweed (Amaranthus retroflexus) and other amaranths. The soil was silt-clay loam. A heavy infestation of grasshoppers in June and July caused damage to the crops and somewhat distorted their yields. Results: At 6 oz./a. rate most of the chemicals have reached, or in some cases passed, the point of crop tolerance. Consequently, some spectacular evidence of injuries were observed. Weedar 64 in oil caused a reduction in yield and serious delay of flax, depressed oats and somewhat retarded wheat and barley. ACP 649 caused blasted florets in oats, depressed flax and retarded other crops. ACP 675 was very severe on flax. ACP 646 depressed barley and flax but was still tolerant to other crops. ACP 658 and 472 were tolerant to all crops. The susceptible weeds were very effectively controlled by most chemicals. Russian thistle was only strongly depressed but not killed by ACP 638, 646, 675 and 472 but was practically eliminated by other chemicals. Wild buckwheat and Amaranthus spp. were only occasionally killed by Weedar 64 in oil or ACP 649, although they were considerably depressed in decreasing order by Weedar 64, 1 pt., 1 qt., 2 qts. oil, ACP 649, Weedone Concentrate 48, Weedar 64 in water, ACP 646, 648, 638, 472 and 675. Agroxone was quite tolerant to all crops, effective on stinkweed and fully ineffective on the other weeds. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Response of spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 8 oz./a. rates, 1949. Pavlychenko, Thomas K. The four spring grain crops, wheat, oats, barley and rye, and flax were treated in quadruplicate plots with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), Agroxone (2 methyl 4 chlorophenoxyacetic acid), ACP 638, 472 (acid of 2,4-D), ACP 646, 648, 649, and 675 (all non-commercial formulations of 2,4-D) at 8 oz./a. rates. The most important weeds present were: stinkweed (Thlaspi arvense), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus), red-root pigweed (Amaranthus retroflexus) and other amaranths. Soil was a silt-clay loam. Results: At 8 oz./a. rate only Weedar 64 in water and ACP 472 were clearly beneficial to flax and to all grain crops. They both killed approximately 80%, and seriously depressed the remaining weeds. ACP 638 and 646 gave reasonably good control of weeds. The grain crops were not seriously depressed but the flax sustained significant injury. Agroxone eliminated stinkweed but permitted Russian thistle to produce seed. All the crops were not injured. ACP 649 was very hard on oats and flax, somewhat depressed height of wheat and barley but their yields were much higher than in checks due to very complete elimination of the weeds. Weedone Concentrate 48 depressed height of all the crops excepting rye, but the yields were equal to or slightly higher than in checks in all cases. Weedar 64 in oil was very effective in destroying weeds but it often caused reduction in the yield of oats, barley, rye and particularly flax. ACP 675 gave incomplete control of weeds and ruined the flax. ACP 472 produced satisfactory yet incomplete control of weeds but was very tolerant to crops, including flax. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Effect of TCA on flax and its residual effect on the following soybean crop. Robinson, R. G. and R. S. Dunham. Nine varieties of flax, badly infested with quack grass, were sprayed with TCA, sodium and ammonium salts, at dosages of 12 1/2, 25, and 50 lbs. (active ingredient) in 40 gals. of water per acre. The flax varieties were sown with a grain drill and replicated 3 times; dosages of TCA were not replicated, and the unsprayed check strip was nearly weed-free. The flax was 3 inches and the quack 10 inches when sprayed on May 27, 1948. All dosages controlled quack until the flax was mature, although 12 1/2 lbs. of the ammonium salt was less effective than the others. Sodium salt at 12 1/2 lbs. and ammonium salt at 25 lbs. gave the highest yields of flax, but even these dosages reduced flaxseed yields about 50% and flax straw yields over 50% of the nearly weed-free check. Minerva showed the most damage. All dosages reduced germination of the harvested flaxseed. Fallow until October completely eliminated the remaining quack grass, and the field was planted to soybeans on May 26, 1949. The soybeans grew normally to a height of 8 inches and then the wrinkled leaf symptoms of TCA toxicity appeared. The crop was a 100% failure except for a small yield on the 12 1/2 lb. dosages. The untreated part of the field yielded more than 20 bushels per acre. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 681, Misc. Jour. Series, Minnesota Agricultural Experiment Station.)

The effect of 2,4-D applied to weed infested Dakota flax at three growth stages. Sexsmith, J. J. Quadruplicate plots of Dakota flax were sprayed in 1949 with sodium salt 2,4-D (4, 8, and 12 oz. per acre), triethanolamine salt 2,4-D (2, 3, 4, and 8 oz. per acre), and butyl ester 2,4-D (2, 3, 4, and 8 oz. per acre) at three growth stages. The growth stages and dates of treatment were:- Stage 1 (June 3) flax 1 to 2 inches tall, Stage 2 (June 20) flax 8 to 10 inches tall, Stage 3 (July 2) flax 14 to 18 inches tall in the late bud to early bloom stage. From the standpoint of weed control, the early (Stage 1) treatments were best, even though some weeds grew after treatment. Under more favorable moisture conditions than existed in 1949,

it is expected that treatments given approximately one week later than Stage 1 would result in better control of a mixed weed population (Russian thistle, flixweed, tumbling mustard, reed-root pigweed, and lambs' quarters). The sodium salt, even at the 12 oz. rate, did not give effective weed control. Good weed control, consistent with satisfactory flax yield, was obtained from the triethanolamine treatments at the 4 and 8 ounce rates, and the 3 and 4 ounce treatments with butyl ester. Least visible damage to flax occured when treated at Stage 1, greatest damage combined with delays in maturity resulted from Stage 3 treatments. Average yields for all treatments at the different growth stages were:- Stage 1 - 10.7 bu. per acre, Stage 2 - 8.5 bu. per acre, Stage 3 - 6.6 bu. per acre. (Contribution of Dominion Experimental Station, Lethbridge, Alberta.)

Effect of early bud stage spraying with 2,4-D on number of seeds per boll in three varieties of flax. Warden, Robert L. Triplicate plots of three varieties of flax, Arrow, Renew and Dakota, were sprayed on July 11, 1949 in the dangerous early bud stage with an ester of 2,4-D at rates of 0, 1/6, 1/3, and 1/2 lbs. acid equivalent in 15 gals. of water per acre. The test area was irrigated on June 30. Warm weather following the irrigation resulted in vigorous flax growth. Visible responses of the flax plants were in direct proportion to the rate of 2,4-D applied. After the bolls had formed it was noticed that in the treated plots some appeared to be ripening prematurely and upon examination of these it was found that the bolls contained almost no seed. Further examination indicated that many of the normal appearing bolls on the treated plots had fewer than ten seeds developing. Twelve plants were harvested at random from the plot guard rows and stripped of their bolls. The first fifty bolls from each of the 36 plots were cut and the number of developing seeds per boll recorded. Statistical analysis revealed that there were no differences between varieties and response of varieties to various rates. There was, however, a highly significant difference between check plots and the plots receiving 2,4-D. There was no significance between the various rates of 2,4-D. The overall reduction was approximately 15 percent. It was noticed that seed coats and bolls developed to almost normal size without the development of cotyledons. Such seed coat and boll development did not take place in hand emasculated flowers. Fertilization followed by ovule abortion may be the possible cause. Similar effects were not observed on flax sprayed at an earlier date. Final yield data are not available at this time. (Contribution of the Agronomy and Soils Dept., Montana Agricultural Experiment Station.)

Control of weeds in flax with selective herbicides. Zahnley, J. W. and G. L. McCall. Three varieties of flax, Redwing, Redson, and Dakota, were sprayed when the plants were 6 to 8 inches high with the three 2,4-D formulations, sodium salt 1/4 and 1/2 pound acid per acre, amine 1/8, 1/4 and 1/2 and ester 1/8. Also Sinox 1:80, Dow selective 1:200 and Aerocyanate 2%. The 2,4-D preparations were applied in 10 gals. water per acre and the other chemicals in 160 gals. water per acre. The ester at 1/8 lb. per acre caused severe damage to the flax while 1/8 lb. of amine and 1/4 lb. of the sodium salt did no damage to the crop but failed to give satisfactory control of the weeds. Aerocyanate 2% killed all weeds including the weedy grasses but caused the flax to lose all its leaves on the lower half of the plant which inhibited subsequent growth. Lower dosages may be more satisfactory for use on flax. Sinox and Dow selective caused no noticeable damage of the flax and gave fair control of the weeds. Results of this test indicate that when using 2,4-D the margin of safety between dosages that give effective weed control and dosages that damage the crop is very narrow. More work is needed to establish this range. The dinitro compounds appear to be somewhat safer to use and offer considerable promise for use on flax that is not badly infested with the grasses. (Contribution of the Kansas Agricultural Experiment Station.)

Project III-7 Use of herbicides on seedling and established legumes.

Summary

Investigation leader: K. P. Buchholtz

Legumes have usually been considered too sensitive to most herbicides to allow their use in these crops for weed control purposes. Abstracts submitted indicate that under at least some conditions medium and mammoth red clover, alsike and ladino clover, alfalfa, sweet clover, Korean lespedeza, peas and soybeans may be treated without serious injury to the crop or reduction in stand.

In many areas small seeded legumes are establishes by seeding them in grain crops. Maintaining stands of these legumes is a problem when the grain is treated later with an herbicide for weed control. The results from different cooperators are not entirely consistent. The maintenance of legume seedings in grain treated with herbicides is dependent on many factors. It is apparent that all conditions causing variation in results have not yet been recognized. In three sweet clover trials it was found to be sensitive to 2,4-D than any other legume tested. In all trials in which they were included ladino clover and alsike clover were more tolerant of 2,4- D than other legumes. Red clover was usually considerably more tolerant of 2,4-D than alfalfa. In one trial from Minnesota the reverse was true. Whenever comparisons were made the amine and sodium salt preparations of 2,4-D were less toxic to the legumes than the esters. This was particularly true for the more sensitive legumes where differences were sometimes very large. MCP appears to be less toxic to red clover, alsike and sweet clover than equivalent applications of 2,4-D. In one trial on sweet clover 2,4,5-T was noticeably more toxic than 2,4-D.

Data on the effects of time of application were not consistent. Results from Ohio showed that the best stands of legumes were obtained when the grain was starting to head. Similar results were reported from Minnesota. In Michigan best results were obtained when the grain was treated at the 8 inch stage. Use of $\frac{1}{4}$ lb. of 2,4-D usually resulted in stands of 50 percent of more of check of even the most sensitive legumes if other factors were favorable. Some abstracts indicate that 1 lb. of 2,4-D has been used without appreciable injury to the legume stands. In general, results have varied from poor in Ohio to fair in Michigan, Minnesota and South Dakota to good in Wisconsin. It is likely that environmental factors not yet recognized cause large differences in the responses of legume seedings to herbicides of this type.

In one trial reported from Nebraska broadleaved and grassy weeds in established stands of alfalfa were controlled effectively by applying 1 lb. of the sodium salt of 2,4-D just as the alfalfa was starting growth in the spring. Various dinitros and sodium 2,4-dichlorophenyl sulfate were somewhat less effective in control of weeds. IPC was effective in control of grassy weeds only. None of these treatments caused visible injury to the alfalfa.

Information from Oklahoma indicated that many weeds in fields of Korean lespedeza may be killed by making application of 2,4-D at several stages of growth prior to bloom. Seed yields of the lespedeza were but slightly affected by applications of as much as 1 lb. of 2,4-D per acre. Ester preparations caused a greater yellowing of the lespedeza leaves than did the use of amines.

In a series of trials in Wisconsin canning peas were treated with herbicides of the growth substance type. Results were generally good. No reductions in yield of shelled peas were evident when $\frac{1}{4}$ lb. of the amine or sodium salt of 2,4-D was

applied. MCP and 2,4,5-T appear more toxic to peas than 2,4-D. Ester preparations caused much more severe injury than the other preparations. To avoid injury to the peas it was essential that the applications be made before the bloom stage. There was only slight evidence that maturity of the shelled peas was affected by treatments that did not seriously reduce yield.

In one trial in Illinois the ester of 2,4-D in diesel oil was used in an attempt to kill cocklebur in soybeans. An application was made as the soybeans were starting to yellow. Defoliation of the soybeans was completed within 48 hours. No pronounced injury to the cocklebur was obtained for they were nearly mature. Applications of 2,4-D to beans that were only 2/3 mature speeded their development and reduced the seed size. From these results it appears that 2,4-D may have a place as a defoliant for soybeans.

It is probable that 2,4-D and related materials can be used for weed control in legume seedings, peas and Korean lespedeza if the weeds involved do not require high rates of application for their control. A number of factors such as growth stage, material, preparation and plant specie are known to affect results. Local conditions also appear to be highly important. They may increase the injury to these plants to the point where use of herbicides is of no practical importance if stands are to be maintained.

Abstracts of Results of Cooperators

Response of red clover and alfalfa seedings to MCP and 2,4-D applied at several rates. Buchholtz, K. P. Red clover and alfalfa seedings in a field of Clinton oats sown at the rate of 1½ bu. per acre were sprayed with an amine preparation of 2,4-D and with sodium salt, amine and isopropyl ester preparations of MCP. All preparations were applied at rates of 0.25, 0.5, 1.0 and 2.0 lbs. per acre in 20 gallons of water when the oats was about 12 inches high and shooting. The 2.0 lb. application of 2,4-D was the only treatment that reduced stands of red clover significantly, and resulted in stands of but 34 pct. of check. By averaging the application rates for 2,4-D and MCP it was shown that 2,4-D was significantly more toxic to red clover than MCP. Average stands were 68 and 96 pct. respectively. The different preparations of MCP did not cause significant differences in red clover stand. Alfalfa stands were reduced significantly by all treatments used. The best stand was obtained with the 0.25 lb. application of 2,4-D which was but 71 pct. of check. The MCP preparation tended to be more toxic to alfalfa than 2,4-D. Average stands obtained with these two materials were 43 and 34 pct. respectively but are not significantly different statistically. In this trial the sodium salt and ester preparations of MCP were significantly more toxic to alfalfa than the amine preparation giving stands of 30, 25, and 46 pct. respectively. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

Affect of 2,4-D and MCP applications on stands of various legumes. Buchholtz, K. P. Red clover, alfalfa, alsike, ladino and white blossom sweet clover were planted in a field seeded to Clinton oats at the rate of 1½ bu. per acre. When the oats was shooting and about 12 inches high plots in each of the legume seedings were sprayed with the amine salt of 2,4-D at rates of 0.25, 0.5, 1.0 and 2.0 lb. per acre. MCP as the isopropyl ester was applied at 1 lb. per acre. Legume counts were made in October several months after the grain had been harvested. Treatments were replicated 4 times and the data were analyzed statistically. None of the treat-

ments reduced stands of ladino significantly. Stands of alsike and red clover were reduced significantly only by the two pound application of 2,4-D, these being but 55 and 38 pct. of check stand respectively. Stands of alfalfa were reduced significantly by the 1 and 2 lb. applications of 2,4-D and the 1 lb. application of MCP. Sweet clover was the most sensitive of the legumes tested showing significant stand reductions for the 0.5, 1.0 and 2.0 lb. applications of 2,4-D and the 1 lb. application of 2,4-D. The MCP preparation appeared to be less toxic to sweet clover, red clover and alsike clover than equivalent applications of 2,4-D but the differences were not significant. The order of increasing susceptibility to 2,4-D appears to be ladino, alsike, red clover, alfalfa, and sweet clover with only small differences among ladino, alsike and red clover. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

Response of canning peas to several herbicides applied at 0.25 lb. per acre. Buchholtz, K. P. Weed free plots of Pride peas were treated with a suspendable preparation of 2,4-D acid, the sodium salt, amine and ester preparations of 2,4-D, sodium salt, amine and ester preparations of MCP and the ester of 2,4,5-T. All applications were made at the rate of 0.25 lb. per acre in water equivalent to 80 gallons per acre when the peas were about 6 inches high. Four replicates were used. Peas on plots treated with the ester preparations of 2,4-D, 2,4,5-T and MCP were severely injured, terminal and axillary buds were killed and growth ceased. Later the plots treated with the ester of MCP partially recovered. The other treatments caused the pea plants to develop a bluish color and thickened the veins of some of the leaves. Growth in general and date of blossoming were not noticeably affected. Yields of shelled peas were not reduced significantly below check by any of the acid, sodium salt or amine preparations. The plots treated with the esters of MCP yielded but 2154 lbs. per acre compared to a check yield of 3819 lbs. By grouping the sodium salt and amine preparations of 2,4-D and MCP it was shown that those treated with 2,4-D yielded significantly better than those treated with MCP. Average yields were 4201 and 3477 lbs. respectively. Tenderometer readings were affected significantly only by the treatment with the ester of MCP which reduced the readings to 87 in comparison with the 125 shown by check. In this trial amine and sodium salt preparations were much less toxic than the ester preparations. They caused no reduction in yield when applied at 0.25 lbs. and did not affect tenderometer readings. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

Yields of canning peas following treatment with 0.25 lb. of 2,4-D on different dates. K. P. Buchholtz. Weed free plots of Pride peas were sprayed with an amine preparation of 2,4-D at the rate of 0.25 lb. per acre at the 2, 6, 12, and 24 inch stage. At the 12 inch stage blossoming had not started. At the 24 inch stage most of the pods were set and starting to swell. Applications were made in water equivalent to 80 gallons per acre. Treatments were replicated 4 times. Peas were picked and shelled in a laboratory sheller. The first three applications applied prior to bloom did not reduce the yields of shelled peas significantly being 4615, 4361, and 5012 lbs. per acre respectively while check yielded 4415 lbs. The application made after the pods had set reduced yields significantly to 2524 lbs. Many of the pods or plants treated at this date swelled rapidly without producing peas. The peas were fairly mature when harvested and gave high tenderometer readings. Peas from plots treated at the 12 inch stage gave an average reading of 168 which was significantly greater than those harvested from check plots which tested 148. The average tenderometer reading of peas from all 2,4-D treated plots was 157 and was significantly greater than check. In this trial yields of peas treated with 0.25 lb. of an amine preparation of 2,4-D were not affected when applications were made prior to bloom. Tenderometer readings were increased somewhat by all dates of 2,4-D treatment. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin).

Canning pea yields following treatment with 3 rates of 2,4-D applied with 3 quantities of water. Buchholtz, K. P. Weed free plots of Pride peas were treated with an amine preparation of 2,4-D at rates of 0.125, 0.25, and 0.5 lbs. per acre when about 6 inches high. All rates were applied in water volumes equivalent to 80, 40, and 20 gallons per acre. Treatments were replicated 4 times and data were analyzed statistically. Peas were picked and shelled with a laboratory sheller. None of the treatments reduced yields of shelled peas significantly below check. Ave. yields for the 0.125, 0.25 and 0.5 lb. applications were 4399, 4042, and 3346 lbs. per acre respectively while check yielded 3881 lbs. Use of the 80, 40 and 20 gallon water volumes also had no significant effect on yield for plots so treated averaged 3929, 3858 and 4000 lbs. per acre respectively. Tenderometer readings in no case differed significantly from check. In this trial shelled pea yields were not significantly reduced by application of as much as 0.5 lb. of the amine salt of 2,4-D per acre at the 6 inch stage and the use of various quantities of water did not affect the toxicity of 2,4-D at the rates studied. (Department of Agronomy, University of Wisconsin, Madison, Wisconsin).

Eradication of volunteer sweet clover by the use of 2,4-D. Carder, A. C. The butyl ester of 2,4-D was applied at 4, 8, 12 and 16 ounces acid equivalent per acre to second-year Arctic sweet clover when in the rosette stage, 6 inches and 12 inches high. Weather was ideal for treatment at all three dates of application. Results indicate the clover to be most vulnerable to 2,4-D when at the 6-inch stage. Treated at this period, 4 ounces of the ester gave over 80 per cent control while 8 ounces effected total elimination. When the clover was treated in the rosette stage the comparable kill by these rates was 53 and 95 per cent, respectively; while when in the 12-inch stage even 16 ounces resulted in frequent instances of partial killing of the stalks only, followed by a thick regrowth from buds below the killed portion. (Dominion Experimental Station, Beaverlodge, Alberta).

Effect of 2,4-D and Dinitro Sprays upon Clover and Alfalfa Seedings made in Oats. B. R. Churchill and B. H. Grigsby Seedings of sweet, ladino, red and alsike clovers, and alfalfa were made with oats as a comparison crop. The rate of seeding of the latter was approximately 1½ bushels per acre. When the oats were 6 to 8 inches high plots were sprayed (in triplicate) using 2,4-D at rates of ¼ and ½ pound acid equivalent per acre and dinitro-phenol at 3/4 pound per acre. A similar set of plots was sprayed at a later date when the oats were about knee high. A check plot was left unsprayed for comparison. Milkweed was not controlled in any of the plots. Other weeds were not troublesome even in check plots. The oats were cut for hay after heading. Plant counts in October showed that dinitro applied at the early stage did not affect stands of legume. When applied late, stands of ladino, red, and alsike clovers were reduced considerably. 2,4-D when applied at ¼ pound rates did not affect stands seriously but when applied early on sweet and alsike clover some reduction did occur. At ½ pound rates, 2,4-D greatly reduced stands of sweet clover regardless of time of application. When applied late ½ pound 2,4-D very seriously reduced stands of red clover and alfalfa and reduced to a lesser extent stands of ladino and alsike clovers. (Michigan Agricultural Experiment Station, East Lansing, Michigan).

Effect of 2,4-D on Korean Lespedeza in the Advanced Stages of Growth. Elder, W. C., and Stephens, J. P., Jr. Applications of ¼, ½ and 1 lb. per acre each of the amine and ester types of 2,4-D were applied on Korean lespedeza when 10 to 12" high and again at the prebloom stage. These applications were made under hot, dry weather conditions. None of the above treatments killed any of the lespedeza plants; however, chlorosis of some leaves occurred in all applications in proportion to the amount of the 2,4-D applied. Estimated chlorosis of the different treatments were:

¼ lb. amine 2,4-D per acre - 15 to 20%
¼ lb. ester 2,4-D per acre - 20 to 25%
½ lb. amine 2,4-D per acre - 20 to 25%
½ lb. ester 2,4-D per acre - 33%
1 lb. amine 2,4-D per acre - 25 to 30%
1 lb. ester 2,4-D per acre - 50%

Seed yields from the treated plots indicated that 2,4-D, even at the heavier rates of application, affected seed production only slightly. Many troublesome weeds found growing in the lespedeza plots were controlled. The ½ lb. rates eliminated perennial western ragweed (Ambrosia psilostachya). (Agronomy Department of the Oklahoma A and M. College Experiment Stations, Stillwater, Oklahoma).

The effect of treating sweet clover underseeded with oats at Scotland with 2,4,5-T and three formulations of 2,4-D at two rates of application and two dates. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized 1 by 8 rod plots of sweet clover underseeded with oats were treated with the butyl ester, triethanol amine salt of 2,4-D and 2,4,5-T at the rates of ¼ and ½ pound acid per acre and sodium salt of 2,4-D at ½ pound acid per acre. Treatments were made on June 9, 1949 when the oats was ready to head and the sweet clover six inches tall and on June 21, 1948 when the oats was headed and the sweet clover 18 inches tall. All formulations eliminated a large per cent of the sweet clover. The ¼ pound application of the amine at the first date of treatment left 76.3 per cent of the original stand. At the second date ¼ pound amine left 46.6 per cent stand. The sodium salt at ½ pound left 28.1 per cent stand on the second date of treatment. The butyl ester and 2,4,5-T varied between 0.2 per cent stand to 17.1 per cent stand. Results indicate there is a variation in the different formulations of 2,4-D as to effect on sweet clover. There is a possibility that the amine and sodium salt of 2,4-D can be used to kill weeds in sweet clover - small grain fields without eliminating the sweet clover entirely. (Agronomy Department of the South Dakota Agricultural Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

Response of legumes to 2,4-D when seeded as undercrops in Bonda oats. Miller, John H. Replicated plots of Grimm alfalfa, biennial white sweet clover, alsike clover, medium red clover and mammoth red clover in oats were sprayed with 3/4, 1/2, and 1/4# of 2,4-D per acre. Applications were made when (1) oats was tillering (4-6 inches tall), (2) heading (12-15" tall), and (3) after harvest (6" stubble). The ester and amine formulations of 2,4-D were used. Applications were made at the rate of 30 gallons of solution per acre. Plant counts were made at treatment and again in the fall on permanent quadrats. All legumes were more severely damaged by the ester formulation than by the amine salt treatments. Reduction was proportional to the dosage applied (51, 56, 76% surivval for 3/4, 1/2, 1/4# of amine and 42, 48, 67% survival for 3/4, 1/2, 1/4# of ester -- all legumes and all dates). Legumes (all dosages) were damaged least when sprayed in oats 12-15" tall (67% survival). Little difference could be observed between the other two dates of application (52% survival, when treated in oats 4-6" tall and 51% survival, when treated in 6" oats stubble). Population changes in the check plots indicate that part of the reduction in legume stands was due to factors other than herbicidal action. This was particularly true for the first two dates of application. Conversion of survival data for these dates of application to a control plot basis, tend to show a greater percent survival than indicated above. Alfalfa appeared most resistant with 74% survival; sweet clover most susceptible (41% survival). Little difference in response could be noted between alsike (54% survival) and the two red clovers (56 and 50% survival). Alsike appeared to be damaged more severely with the early application in relation to the other legumes. Satisfactory control of broadleaves annual weeds such as cocklebur,

wild mustard, and ragweed was obtained with all dosages. (U. S. D. A. Bureau of Plant Industry, and Division of Agronomy and Plant Genetics, University of Minnesota.)

Use of herbicides for annual weed control in alfalfa. Shafer, Neal E. Annual weeds such as kochia, pigweed, lambsquarters, downy brome, and little barley are often a problem in the first cutting of alfalfa in Nebraska. Later cuttings may be troubled with quantities of foxtail, barnyard grass, and crabgrass. Nine different herbicides were applied to duplicate 8' x 16' plots. Treatment was made April 19 when the alfalfa was from emerging to 3-5 inches in height, but prior to emergence of most weed species. Many weed species were delayed in germinating by the presence of a cover of weed residue left from the previous year. This residue was burned April 9. Sinox general and K-1131 at 1 pound and 2 pounds and Sinox W and Dow selective at 4 pounds and 8 pounds gave 60 per cent to 70 per cent control of all weeds for approximately four weeks with no harmful effect on the alfalfa. One pound of 2,4-D sodium salt gave 80 to 90 per cent reduction in broadleaf species and 50 to 60 per cent reduction in grassy weeds with no visible effect on the alfalfa. Weed control through herbicidal action and competition of the alfalfa lasted until the alfalfa was cut. Carbon and Carbide Company's Herbicide No. 1 at 1 pound and 4 pounds per acre also gave good weed control (60 to 90 per cent) without injury to the alfalfa. Herbicide No. 2 caused a browning of weeds and alfalfa at rates of one pound and 4 pounds per acre. I. P. C. at 2 pounds and 8 pounds per acre effectively controlled little barley, green and yellow foxtail, and barnyard grass with injury to the alfalfa. Sodium pentachlorophenate at 8 pounds and 10 pounds per acre caused no damage to weeds or alfalfa. (Nebraska Agricultural Experiment Station, Department of Agronomy).

The effect of 2,4-D on clovers and alfalfa sown in small grain. Shaw, W. C. and C. J. Willard A mixture of alfalfa, 6 pounds, red clover, 4 pounds, and Ladino clover, 1 pound, was sown on March 8 in Thorne wheat and on April 12 in Clinton 59 oats which were treated at 10 and 9 stages, respectively, (including pre-emergence in each grain) with the amine salt and the butyl ester of 2,4-D at 0, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4 pounds per acre at each stage, four replications of each rate. Perfect stands of legumes were obtained after all fall treatments of wheat. Most of the stands in oats following pre-emergence treatments were fair, though somewhat less than the checks. Slightly better than half stands, mostly Ladino, were obtained following about half the spring treatments of $\frac{1}{4}$ or $\frac{1}{2}$ pound, mostly at the very advanced stages of maturity (late joint and later, after the more practical stages of treatment). Legume stands were usually practical failures in wheat and oats treated at the recommended stages for weed control. Whenever there was a legume stand remaining, weed control was likewise imperfect. There was no alfalfa on any treated plot, and only a little red clover. While it is obvious that partial stands of legumes may remain after treating small grain with 2,4-D at late stages, we cannot recommend treating small grain in which legumes are sown with 2,4-D. (Dept. of Agronomy, Univ. of Ohio, Columbus, Ohio.)

Preharvest weed control in soybeans. Slife, F. W. and Fuelleman, R. F. Weed chemicals were applied by plane to nearly mature soybeans for the purpose of knocking down weeds to permit easier harvesting of the soybeans. These tests were carried out in bottomland areas where cocklebur (Xanthium sp.) was particularly bad. Chemicals and rates used per acre were: 1/3 pound of ester in 3 gallons of diesel fuel, 2/3 pound of ester in 3 gallons of diesel oil, 1 pound of ester in 3 gallons of diesel oil, 2/3 pound of ester in 6 gallons diesel oil, and 2 gallons of Shell 130. These chemicals were applied when a slight trace of yellowing in the bean leaves could be observed indicating near maturity. The cocklebur plants in this particular test had set buts and were not affected to any extent by the treatments. The soy-

bean plants in the treated areas lost the majority of their leaves within 48 hours after treatment. Other beans were treated when the beans were two-thirds developed in the pods. In these tests the bean plants begin to mature faster than the check plants indicating that growth had been slowed up or stopped. The beans harvested from the treated areas were below normal in size. (Illinois Agriculture Experimental Station, Urbana, Illinois).

PROJECT III. EFFECTS OF HERBICIDES IN GROWING CROPS

Summary

Investigation Leader:
P. J. Olson.

1. Spring planted wheat, oats and barley.

Investigations under this head included studies of the effect of 2,4-D at different stages of growth, comparison of different formulations, different rates of application, and differential response of varieties to treatment. Effects on yield, morphologic features and quality were studied.

A. Effect of treatment at different stages of growth.

Olson, Breakey and Brown in Manitoba applied ester at 8 to 12 lbs. acid per acre to wheat and barley at twenty stages of growth starting before emergence of the crop and continuing at approximately 3 day intervals until after heading. In both crops there were two rather widely separated periods during which severe damage was done as measured by yields that were sharply reduced as compared with the immediately preceding and immediately following treatments. The first was an early period when the plants ranged from 3/4 inch to 5 inches tall. The second was a much later period shortly before heading in barley and about 11 or 12 days before heading in wheat. These results were obtained at three widely separated stations in Manitoba, and were in good agreement with each other.

At Scott, Saskatchewan, Frieson obtained results with wheat, oats and barley, where he applied ester, amine and sodium salt at 15 stages, that were similar in pattern to the Manitoba results except that the later period damage to wheat occurred at stages nearer heading. The results with oats resembled those with wheat and barley as far as the most severe damage was concerned, but differed in that here some damage was done at the stages between the two critical periods as well. Little damage was done by sodium salt.

At Lethbridge, Alberta, Sexsmith treated spring wheat and barley with amine and ester at five stages of growth and noted that floret sterility was greatest in the shot blade stage in the case of wheat and the boot stage in the case of barley. This seems to agree fairly well with the Manitoba results for these crops.

Davidson at Indian Head, Saskatchewan, treated oats at 3 stages, namely 3 leaf, early shot blade and early heading. The greatest damage took place at the three leaf stage. At the other stages damage was slight or doubtful. The maximum rate of application was 8 ounces per acre. Ester did the greatest damage and Sodium salt the least. Godbout in Quebec also applied ester and amine to oats at three growth stages, namely 3 leaf, 5 leaf, and shot blade. The rates of application were 2, 4 and 8 ounces per acre. The results agree with those of Davidson just described in that greater damage was done at the 3 leaf than the shot blade stage. Ester again did greater damage than amine.

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Amine and ester applied by Shaw and Willard to Clinton oats at 8 stages beginning at the 2 leaf and continuing to late milk at 1/4, 1/2, 1, 2 and 4 pounds acid per acre. They reported the greatest injury at the 2 leaf stage when highly significant injury was caused by all rates above 1/4 lb. Apart from this stage the 1/4 and 1/2 pound rates produced only slight injury at any stage. The least injury was caused at the 4 leaf and early milk stages. Ester caused greater damage than amine at corresponding rates.

Slife and Fullerman, in Illinois, treated oats when they were fully tillered, but had not begun to joint, with ester at rates of 1/4, 1/2 and 3/4 lb. acid per acre. Sharp yield reduction took place at the 1/2 and 3/4 pound rates.

Amine and ester were applied at varying rates from 2 ounces to 1 pound acid per acre, by Shafer in Nebraska, to Nemaha oats at 4 stages of growth, namely jointing, early boot, late boot and flowering. When applied at the jointing stage ester, at all rates above 1/4 pound, reduced yields significantly. At the other three stages no significant damage was suffered.

Carder at Beaver Lodge, Alberta, applied ester 2, 4, 6, 8, 12 and 16 oz. to Saunders wheat at the 5 leaf stage. All rates above 2 ounces reduced yields. Those, above 4 oz., caused severe reductions.

Taylor at Agassiz, British Columbia, treated oats with ester at 2, 4, 6 and 8 ounces acid per acre. The oats had been sown to red clover. The treatment was made when the oat crop was 10 - 11 inches tall. No significant yield reduction in the oats took place.

B. Differential response of varieties to 2,4-D.

Fourteen varieties of wheat, 13 of barley and 16 of oats were involved in the investigations reported. Seven stations are represented. Davidson in Saskatchewan compared Ajax, Vanguard, Fortune and Exeter. Olson and Breakey in Manitoba compared Ajax, Vanguard and Exeter. In both cases Ajax was found somewhat more susceptible to damage and Exeter the least. Ajax is early and Exeter late. Vanguard was a close second to Ajax in damage suffered in Manitoba. Ajax showed slightly greater reduction in yield than Erban in a comparison by Godbout in Quebec. Shaw and Willard, in Ohio, compared Columbia, Ajax and Mindo. These are named in the order of injury from the least to the greatest. The authors point out that these varieties did not rank in the same order under similar treatment applied last year. Eleven varieties were treated with an ester by Foster of Regina. He reported that Gopher, Vanguard and Valor were the most tolerant and Anthony the most susceptible. Ajax, Beacon, Brighton and Vanguard showed many head deformities. Other varieties included in the test were Garry, Victory, Banner, Exeter.

Breakey and Olson compared Thatcher, Redman, Regent and Carleton wheat at Morden, and Thatcher, Redman and Stewart at Winnipeg, Manitoba. Regent was the only variety that suffered significant reduction at Morden. The reduction was slight. Redman and Stewart showed slight damage at Winnipeg.

Hoggeness and Letourneau at St. Paul, Minnesota, compared Rival and Mida under four amine and one ester formulation. Both Mida and Rival suffered significant yield reduction from the ester treatment. Two of the amine formulations reduced the yield of Rival.

In a test involving 11 varieties of wheat, Foster at Regina found Renown and Saunders most tolerant. Rescue and Thatcher were the most susceptible. The other varieties involved were Regent, Reward, Redman, Apex, Marquis, Cadet and Red Thatcher.

Trials with barley were reported by Olson and Breakey for Winnipeg, Manitoba, and Foster for Regina, Sask. Montcalm showed the most consistent yield reduction at Winnipeg and Vanguard the least. Amine and ester were applied at 4 and 8 ounces acid per acre. Out of 14 varieties treated with ester at 8 ounces, Foster reported Warrior, O.A.C. and Compana most tolerant, and Trebi, Prospect and Vantage most susceptible. The other varieties included were Montcalm, Olli, Regal, Colsess, Hannchen, Titan, Plush, Velvon and Compana. Evidently there is no agreement between the Winnipeg and Regina results.

Helgeson at Fargo, North Dakota, treated Mida, Regent, Rival, Pilot bread wheats, and Mindum and Carleton durum at the fully tillered stage with ester, amine and sodium salt at one pound acid per acre. No differential response of varieties was reported. Only the ester formulation caused any marked reduction in yield or other damage. Ester reduced the yield of all varieties by an average of 4 bushels, reduced the average height by 2 to 3 inches, and caused a slight reduction in average test weight.

C. Effect of 2,4-D on quality.

Frieson, at Scott, Saskatchewan, treated wheat with three formulations at 4, 8 and 16 ounces per acre. The applications were made at four stages, namely pre-emergence, 3 leaf, shot blade and late flowering. This work was done in 1947 when growing conditions were unfavorable. Milling and baking qualities were not affected.

From trials at Bozeman, Montana, Warden reported effect on protein content in Thatcher, Ceres, Rescue, Supreme and Onas wheats treated with 1/3, 2/3 and 1 pound of ester at early tillering and full tiller stages. There was a highly significant increase of protein with increased rates, although the maximum increase was only .86 per cent. There was no evidence of differential response as between varieties.

D. Effects of different herbicides.

Pavlychenko, at Saskatoon, applied several commercial brands of 2,4-D to weed infested spring wheat, oats, barley and rye at two stages. One of these stages was described as "near the boot" and the other "24 days after emergence." The rates were 2, 4, 6 and 8 ounces acid per acre. Weedar 64 (amine salt of 2,4-D) was severe on all crops at both stages particularly at 6 ounces and above. ACP.649 (2,4-D) did severe damage to oats and barley, particularly at the 6 and 8 ounce rates. ACP.648 (2,4-D) depressed all crops considerably at the "near boot" stage. ACP.472 (2,4-D) was beneficial to crops in some cases and caused little or no damage in any case. It also produced incomplete control of weeds.

Helgeson, in North Dakota, applied Butyl ester, E.H. No. 1 and L.F.N. 472 at several concentrations up to one pound per acre to Mida wheat at the tillering stage. No significant reduction or increase in yield, test weight or height of plant was noted for any of the treatments.

Buchholtz at Madison, Wisconsin, treated Clinton oats at 12 inches high with MCP in the form of sodium salt, amine and isopropyl ester and 2,4-D as the amine salt. The rates used were .25, .5, 1.0 and 2 pounds per acre. Significant reduction in yield was caused only by the 2 pound rate of 2,4-D. Yields under treatment with MCP were significantly higher than under 2,4-D. No significant differences were found between the MCP preparations.

E. Effect on weeds in cereals.

Ficht, at Swift Current, Saskatchewan, applied triethanolamine, alkanolamine, butyl ester, ethyl ester and sodium salt at 2,4 and 16 ounces for the amines and ester and 4, 8 and 32 ounces for the sodium salt to wheat, oats and barley infested with Russian thistle. The applications were made at two stages, namely beginning of tillering (five to six weeks after seeding) and "near shot blade" thirteen days later. Sodium salt gave no appreciable control except at 32 ounces. Some of the 4 ounce and all of the 16 ounce treatments of the other formulations gave complete control. Yields of the crops were decreased markedly under the 16 ounce treatments. Sexsmith at Lethbridge, Alberta treated wheat and barley, which had a heavy infestation of Russian thistle. Applications of ester and amine were made at 5 dates, the first when the Russian thistle was 1 inch tall in the "pine leaf" stage, and the last 29 days later, when they were up to 2 inches tall. Weed control increased with increased rates and decreased with delay in treatments. Very satisfactory control was obtained with all treatments at the first stage and with all but the 2 ounce ester treatment at the second stage. Treatments at the later stages gave unsatisfactory results.

F. Effect on clovers and alfalfa sown in small grain.

A mixture of alfalfa, red clover and ladino clover was sown with Thorne wheat and Clinton 59 oats by Shaw and Willard in Ohio, and treated with amine and ester. The applications were made at 10 stages in wheat and 9 in oats, these including pre-emergence in each case. Rates of application ranged from 1/4 to 4 pounds acid per acre. Legume stands were practical failures at the stages recommended for weed control. The authors conclude that treating with 2,4-D is not to be recommended in the case of small grains with which legumes have been sown.

Taylor, at Agassiz, B.C., treated oats which had been seeded to clover. All treatments showed a significant reduction in stand of clover except the 2 ounce ester treatment, and the Dow Selective at 1 2/3 quarts per acre. The rate of survival ranged from 92.7 to 21.8 per cent as the rate of application of ester increased from 2-8 ounces.

PROJECT III. EFFECTS OF HERBICIDES IN GROWING CROPS.

Abstracts of Results of Individual Cooperators.

1. Spring Planted Wheat, Oats and Barley.

Effect of 2,4-D on grain crop, barley. Formulations and rates at one date of treatment 1948-49. Brown, D. A. Montcalm and Vantage varieties were used for this experiment. Quadruplicate rod-row plots were employed and all treatments applied as a water spray. Formulations included butyl ester, amine and sodium salt. Rates were 4, 8, 16 and 24 ounces acid equivalent per acre. Treatment was made when the crop was considered to be at the best stage, namely, 8 inches, or very early shot blade. In 1948 lodging was significantly more severe on all treated plots and weakness increased sharply with increased rate. Yields from all treated plots were significantly lower than checks especially as higher dosages were reached. Dry weather in 1949 induced a stronger straw and while there was weakening of straw from the 8 ounce application upward this did not significantly depress the yield. Check plots of Vantage yielded consistently higher than any of the treated plots. The difference in Montcalm was not so marked. In fact the sodium treated plots averaged a higher yield than the check in this variety. There was a slight but not significant lowering of yields as dosages increased except in the ester treated plots where higher rates definitely reduced yields. Length of straw was not influenced by any of the formulations or rates. It can be said that when barley plants are 8" high injury to the crop by the application of 2,4-D up to 6 ounces acid equivalent of ester, 8 of amine and 10 of sodium, will not be significant. Above these rates weakened straw, sterile glumes and subnormal heads are likely to depress the yield. (Contributed by Dominion Experimental Farm, Brandon, Manitoba.)

Oat yields following treatment with MCP and 2,4-D at several rates: Buchholtz, K. P. Clinton oats was treated with MCP as the sodium salt, amine and isopropyl ester preparations and with 2,4-D as the amine salt. All materials were applied at rates of 0.25, 0.5, 1.0 and 2.0 lbs. per acre. Applications were made in water equivalent to 20 gallons per acre when the oats was 12 in. high and shooting. Untreated check plots yielded 74.9 bu. per acre. The only treatment which reduced the yield significantly was the 2.0 per acre of 2,4-D. By grouping the MCP and 2,4-D treatments it was shown that the MCP treated plots gave significantly higher yields than the 2,4-D treat plots. Ave. Yields were 71.6 and 65.6 bu. per acre respectively. There were no significant differences among the three MCP preparations. (Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.)

The effect of 2,4-D on spring wheat. Carder, A. C. The butyl ester of 2,4-D was applied at 2, 4, 6, 8, 12 and 16 ounces acid equivalent per acre to Saunders wheat in the early shot blade stage. Results indicate that 2,4-D treatments to spring wheat should be as light as consistent with effective weed control. All rates other than the 2-ounce dosage decreased yields markedly. Yield curtailment was serious when 6 or more ounces were applied. On the other hand, kernel weight was not greatly reduced by the various applications, suggesting that suppression of yield is probably due more to reduction of kernel number

than to kernel size. Had the chemical been applied at an earlier growth stage of the wheat injury would have been undoubtedly less. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta.)

Effect of 2,4-D on spring planted oats when applied at four rates and three different growth stages. Davidson, J. G. Ajax, Vanguard, Fortune and Exeter oats were sprayed at the three-leaf, early shot blade and early heading stages with 2, 4, 6 and 8 ounces and equivalent of sodium salt, amine and ester formulations of 2,4-D. Browning of the leaves after treatment with the ester at the three-leaf stage was quite marked at the 4, 6 and 8 ounce rates. At the three-leaf stage yields tended to be progressively reduced with the sodium, amine and ester formulations in that order with Ajax mainly showing the greatest reduction and Exeter the least. At the early shot blade stage reductions in yield were less than at the three-leaf stage; in fact, Ajax was increased at 2, 4, and 6 ounce rates and Vanguard, Fortune and Exeter stimulated at the 2 ounce rate. Treated at early heading the yield reductions were again less than at the early shot blade stage while the difference between varieties was not so pronounced. The sodium salt did the least injury and the amine less than the ester. Off-type heads were not observed in the plots treated at the early shot blade or early heading stages. Treated at the three-leaf stage off-types were numerous, particularly with the ester treatments, with Vanguard and Exeter showing the most. (Contribution of the Dominion Experimental Farm, Indian Head, Sask.)

Effect of 2,4-D on cereals. Picht, Jos.. Five formulations of 2,4-D were used, namely, triethanolamine, alkanolamine, butyl ester, ethyl ester, and sodium salt. Applications were at rates of 2, 4, and 16 ounces acid equivalent per acre in the case of the amines and esters and at double these rates for the sodium salt. Treatments were applied with a boom sprayer (30') on fields of Rescue wheat, Stewart durum wheat, Ajax oats, and Titan barley. The first application was made when the cereal seedlings were starting to develop tillers, at five to six weeks after seeding. The second series of treatments were applied thirteen days later when the grain was approaching the shot blade stage. All crops were on reasonably well prepared summerfallow but the infestation of Russian thistle ranged from fairly dense in the oats to a light infestation in the durum wheat. Drought conditions reduced the yields of all crops to around ten bushels per acre. The control of Russian thistle growth varied from a severe setback in the 2-ounce treatments to complete control in some of the 4-ounce treatments and all of the 16-ounce treatments. Sodium salt gave no appreciable control except at 32 ounces. Yields taken from treated areas and untreated checks indicate no increase from 2,4-D treatments, but show a marked trend toward decreased yields of the above crops on plots receiving the 16-ounce treatments. (Contribution of the Dominion Experimental Station, Swift Current, Saskatchewan, Canada.)

Effect of 2,4-D on different varieties of barley. Foster, J. Roo. An ester formulation of 2,4-D was applied at the rate of 8 ounces of acid per acre to 14 varieties of barley at 2 stages of growth. The varieties in the test were Olli, Warrior, Montcalm, Regal, Prospect, Colsess, Trebi, O.A.C. #21, Hannchen, Titan, Plush, Velvon, Vantage, and Compana. Applications were made June 14th and 28th when the barley was in the 3 and 5 leaf stages, respectively. Warrior, O.A.C. #21,

and Compana were the most tolerant from the standpoint of yield, while Trebi, Prospect and Vantage were the most susceptible. There was very few deformities in heads at the rate and dates sprayed, but the most deformities were in Warrior with 8% and Trebi with 6%. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

Effect of 2,4-D on different varieties of oats. Foster, J. Roe. An ester formulation of 2,4-D was applied at the rate of 8 ounces of acid per acre to 11 varieties of oats at 2 stages of growth. Varieties in the test were Gopher, Ajax, Garry, Vanguard, Exeter, Victory, Anthony, Banner, Beacon, Brighton and Valor. Applications were made June 14th and June 28th when the oats were in the 3 and 5 leaf stages, respectively. Gopher, Vanguard and Valor varieties, in that order, were the most tolerant from a yield standpoint. Anthony was the most susceptible and showed the greatest decrease in yield. Very few deformities were apparent at the rate and dates treated, but Ajax, Beacon, Brighton and Vanguard had more than the other varieties. These deformities consisted of greatly elongated spikes of 2 or 3 spikes arising from the same node. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

Effect of 2,4-D on different varieties of hard red spring wheat. Foster, J. Roe. An ester formulation of 2,4-D was applied at the rates of 2, 4 and 8 ounces of acid per acre to 11 different varieties of hard red spring wheat at two stages of growth. Varieties in the test were Saunders, Regent, Renown, Reward, Thatcher, Redman, Rescue, Apex, Marquis, Cadet and Red Thatcher. Applications were made on June 14th and 28th when the wheat was in the 3 and 5 leaf stages respectively. Renown and Saunders were the varieties most tolerant to the ester treatment from the standpoint of yield. Rescue and Thatcher were the most susceptible and showed the greatest decrease in yield, Rescue, Thatcher and Red Thatcher had the greatest percentage of deformed heads while Reward had the fewest. Deformities included fused glumes, fused lemmas, missing glumes, twisted glumes, uneven spacing of the spikelets on the rachis, and two or more spikelets arising from one node on the rachis. Heading was delayed 3 days with Renown but only one day with the other varieties. This test indicated that there are definite variations in varietal tolerance in wheat to the ester formulation of 2,4-D. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

The effect of 2,4-D on wheat when applied at different growth stages. Foster, J. Roe. Sodium, amine and ester formulations of 2,4-D were applied to Thatcher wheat at rates of 2,4, and 8 ounces of basic acid per acre. Spraying was done on 64 of the 82 days between May 23rd and August 15th. Only 2 days were missed in June, and the longest interval between spraying was 5 days. Yields were generally reduced slightly regardless of the date, rate, or formulation of the treatment, but the least reductions occurred when sprayed 16 to 20 days after emergence with the ester, 13 to 16 days after emergence with the amine, and 7 to 13 days after emergence with the sodium salt. Heading was delayed from 1 to 3 days when sprayed with ester within 31 days after emergence, and to a lesser extent up to 40 days after emergence. Amine and sodium salts delayed heading less than the ester.

Head deformities were frequent in the ester treated rows, and occurred to a lesser extent with the amine and sodium salt formulations. Early treatments resulted in the most deformities, and were rare 20 days after emergence with sodium salt, and 33 days after emergence with ester and amine treatments. (Contribution of Dominion Department of Agriculture, Experimental Farms Service, Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

The effect of 2,4-D on barley when applied at different growth stages. Foster, J. Roe. Sodium, amine and ester formulations of 2,4-D were applied to Montcalm barley at rates of 2,4, and 8 ounces of basic acid per acre. Spraying was done on 64 of the 82 days between May 23rd and August 13th. Only 2 days were missed in June, and the longest interval between sprayings was 5 days. The effect of spraying on yield was small on all plots. Treatments with the ester 3 days after emergence delayed heading from 9 to 13 days, and treatments from the 4th to the 29th day delayed heading from 1 to 6 days. Spraying with ester in the shot blade stage delayed heading 1 to 5 days. The amine delayed heading from 1 to 9 days when sprayed within a week of emergence, and thereafter from 1 to 5 days on scattered dates to the early heading stage. There was no definite date at which the sodium salt delayed heading more often than at any other date. With a few minor exceptions, deformed heads were confined to barley treated within the first 8 days after emerging for the ester treatments, between the 3rd and 7th day for the amine treatments, and from the 1st to the 6th day for the sodium treatments. (Contribution of the Dominion Department of Agriculture, Experimental Farms Service. Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

The effect of 2,4-D on oats when applied at different growth stages. Foster, J. Roe. Sodium, amine, and ester formulations of 2,4-D were applied to Exeter oats at rates of 2,4 and 8 ounces of basic acid per acre. Spraying was done on 64 of the 82 days between May 23rd and August 13th. Only 2 days were missed in June, and the longest interval between spraying was 5 days. Yields were sharply reduced by all ester treatments applied within 33 days after emergence, or before June 30th. Reductions were considerably smaller where amine was used within 19 days of emergence, but were quite large between the 20th and 37th day after emergence. Sodium salt caused little reduction in yield when applied between the 8th and 33rd day after emergence. Heading was delayed from 1 to 9 days when the ester and amine were sprayed within 3 weeks of emergence, and when applied in the shot blade stage. Sodium salt delayed heading up to 8 days when applied between the 4th and 11th day, and between the 16th and 19th day after emergence. Sterile florets were more numerous on all rows treated before the 7th day after emergence. Spraying between the 16th and 23rd day gave the crop a tendency to lodge. At the 16th, 17th, and 18th day the leaves were curled longitudinally giving a reed-like appearance, and these plants had a peculiar sheen on the spikelets not found in the checks. (Dom. Dep't. of Agriculture, Exp. Farms Service, Dom. Exp. Sub-Station, Regina, Saskatchewan, Canada.)

Effect of 2,4-D on spring sown barley. Frieson, H. A. Three formulations of 2,4-D were sprayed on Titan barley at the following rates of acid per acre, viz: ester and amine at 4 and 12 ounces, and sodium salt at 12 ounces. The treatments were made at 15 stages of

crop growth beginning 3 days prior to emergence and ending at the hard dough stage. All plots had ample moisture for growth and were kept weed free by hoeing.

None of the treatments at stages 1 and 2, which were pre-emergent, had a significant effect on yield. However, all had a slight but temporary effect on the morphological characteristics, particularly the awns. At stages 3 to 6 deformities of almost all morphological characters were observed, the occurrence and severity of which increased in the following order of treatment rates; sodium salt 12 ounces, amine 4 ounces, ester 4 ounces, amine 12 ounces and ester 12 ounces. The last treatment had up to 100 per cent of deformed plants. All treatments depressed the yield. Severe frost occurring four days prior to stage 5, accentuated the damage. Treatments at stages 7, 8, 9 and 10 had no significant effect on yield or agronomic factors. Treatments at stages 11, 12 and 13 just prior to and after heading resulted in extensive lodging and sterility particularly in the ester and amine plots treated at the rate of 12 ounces per acre. Significant yield reductions were observed after all but the sodium salt treatment. All treatments caused some lodging, when applied during milk and dough stages (Stages 14 and 15) however, the yield differences were not significant. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949)

Effect of 2,4-D on spring sown wheat. Friesen, H. A. Three formulations of 2,4-D were sprayed on wheat at the following rates of acid per acre; ester and amine at 4 and 12 ounces; sodium salt at 12 ounces. Treatments were made at 15 stages of growth, beginning 3 days prior to emergence and ending when the grain was in the milk stage. All plots were kept weed free by hoeing.

At stages 1 and 2, none of the treatments affected the yield. The 12 ounce rate of amine and ester caused some temporary head deformities. At stages 3 and 4 when the crop was fully emerged, head and leaf deformities were abundant. However, only the ester at 4 and 12 and the amine at 12 ounces resulted in significant yield decreases. Plant reaction at stage 5, four days after severe frost was identical to that at stage 3. At stage 6, three weeks after emergence, significant yield reductions resulted from amine and ester at 12 ounces. At stages 7 and 8 the treatments had no significant effect on yield. At stages 9, 10, 11 and 12, made during early shot blade to pre-heading, all treatments resulted in a spreading or lodging effect which increased with date of treatment and dosage. At stages 11 and 12 the heavy amine and ester rates also depressed the yield. Maturity was delayed 2 to 4 days. At stage 13, 3 days after heading, lodging and stem brittleness were severe and significant yield reductions resulted from all treatments. The last two dates resulted only in some lodging and stem brittleness. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effect of 2,4-D on spring sown oats. Friesen, H. A. Three formulations of 2,4-D were sprayed on Ajax oats at the following rates of acid per acre, viz: ester and amine at 4 and 12 ounces, and sodium salt 12 ounces. The treatments were made at 15 stages of crop growth beginning 3 days prior to emergence and ending in the soft dough stage. All plots had ample moisture for growth and were kept weed free by hoeing.

All treatments, at stages 1 and 2, had no effect on yield but caused slight morphological deformities. At stages 3 to 6 (emergence until the crop had been up 22 days) all treatments tended to cause

leaf fusion and stem curling, which prevented many of the panicles from emerging. Severe frost occurred at stage 5, which coupled with spraying retarded growth and vigor. Significant yield reductions were noted following each treatment, at each of these stages except sodium salt. The degree of deformity and yield depression for each treatment and rate was in ascending order of: sodium salt 12 ounces, amine 4 ounces, ester 4 ounces, amine 12 ounces and ester 12 ounces. Maturity was delayed 2 to 7 days. At stages 7, 8, 9, 10, 11 and 12 all treatments caused some lodging and sterility, which at the 12 ounce rates of amine and ester was sufficient to depress the yields. At stages 13, five days after heading all treatments resulted in significant yield depressions. None of the treatments had any significant effect on the crop when applied in the milk and soft dough stages. (Stages 14 and 15). (Contr. by Dom. Exp. Station, Scott, Sask. 1949)

Effect of 2,4-D on the quality of spring wheat and linseed flax. Frieson, H. A. In 1947 three formulations of 2,4-D at rates of 4, 8 and 16 ounces of acid per acre were sprayed on Rescue wheat and Royal flax. The wheat was sprayed at four stages of growth viz: 1) pre-emergence, 2) 3 leaf, 3) shot blade and 4) late flowering stages, while the flax was sprayed when 4 inches tall. Growing conditions were extremely unfavorable throughout the season.

Mr. A. G. O. Whiteside, Cereal Division, Ottawa, made the analysis on the wheat. His comments were, "Our data would not appear to indicate that the 2,4-D applied at the rates used in this experiment affected the milling and baking qualities of the wheat."

The National Research Laboratory tests showed that the oil content and iodine values of the treated flax was essentially equal to that of untreated flax.

Samples of wheat and flax treated with 2,4-D in 1949 in the same manner as in 1947, again showed little or no effect on the milling and baking qualities of the wheat. The oil content of the flax was not affected but the iodine value for nearly all treated samples was very slightly lower than it was for the untreated samples. Growing conditions in 1948 were essentially as unfavorable as they were in 1947. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effect of 2,4-D on oat varieties. Godbout, Eugene. This experiment is underway to determine the effect of two types of 2,4-D namely ester and amine on two varieties of oats (Ajax and Erban). Both types of 2,4-D were applied when grain was in three leaf stage at three different rates, namely 1/8, 1/4 and 1/2 pound acid per acre on plots one square rod in area. Above treatments were replicated three times and randomized in replicated blocks. Notes on date of maturity and grain yields were recorded. Forty days after treatment, it was observed that the rate of 1/2 pound acid per acre on both forms had somewhat reduced the tillering of the two varieties (Ajax and Erban) and produced a light head deformation associated with a weakening of straw on Ajax oats treated with ester type but had not materially affected head formation and strength of straw of these two varieties. The application of 1/2 pound acid per acre had also delayed the maturity by two days.

Yields are erratic for the 1/8, and 1/4 pound rates, but they are constant enough with the 1/2 pound rates. The Ajax and Erban varieties treated at the 1/2 pound rates have yielded respectively 19% and 14% less than the check.

Both forms of 2,4-D used at that rate have had a similar effect on each variety. (Contributed by Ste.Anne de la Pocatiere Exp. Station, Quebec.)

Effect of 2,4-D on oats crop at different growth stages. Godbout, Eugene. This experiment was conducted to determine the effect of two formulations of 2,4-D namely ester and amine on the oat crop when treated at three different growth stages.

Both formulations of 2,4-D were applied when oats was in the three, five and shot blade growth stages at three different rates namely 1/8, 1/4 and 1/2 pound acid per acre on plots one square rod in area.

Above treatments were replicated three times and randomized in replicated blocks. Notes on the effect of each treatment on head formation, strength of straw, date of maturity and grain yields were recorded.

Both forms of 2,4-D used at the 1/2 pound rate of acid per acre slightly affected head formation and strength of straw only when applied to the five leaf stage but delayed the maturity by two days with the three growth stages.

At that rate and for both types, the shot blade stage was the least injured followed by the five and three leaf stages. By taking all rates of the two types of 2,4-D, we still have similar results. In fact, in the first case, yields were respectively 61.2, 54.9 and 51 bushels. In the last case, they were 64.3, 55.5 and 55.2 bushels. Also it is interesting to note that the ester type at the rate of 1/2 pound acid per acre affected the yield with all growth stages, while the amine type at the same rate seems to have reduced the yield of the three leaf stage only. (Contributed by Ste. Anne de la Pocatiere Exp. Station, Quebec.)

Response of wheat to various 2,4-D formulations. Haggeness, H.G., and Duane Letourneau. Four amine formulations (triethylamine, diethylamine, diethylaminoethanol, and dimethylamine) of 2,4-D supplied by Sharples Chemicals Inc. and an ester formulation were applied to plots of Rival and Mida wheat at the rate of ½ pound per acre during 1949. Applications were made when the wheat was in the tillering stage. The triethylamine and diethylaminoethanol formulations did not affect the yield of Rival wheat. The diethlyamine, dimethylamine, and the ester formulations decreased the yield of Rival wheat significantly. On Mida wheat, none of the amine formulations affected yield adversely, but the reduction in yield by the ester was highly significant. (Contributed by Minnesota Agric. Exp. Station, University Farm, St. Paul, Minnesota.)

Reaction of Mida wheat to varied concentrations of 2,4-D applied at tillering. Helgeson, E. A. These tests were designed to bring out any harmful or stimulatory effect of several formulations. Mida wheat growing in weed free plots was sprayed with aqueous solutions of butyl ester, E.H. No. 1 and L.F.N. 472 at tillering. Forty gallons of spray per acre was applied in all instances. Four replicates of each treatment were used, plots being randomized. Concentrations of butyl ester were 3/4, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128 and 0 lbs./acre acid equivalent; for E.H. No. 1: 1 1/2, 1, 3/4, 1/2 and 0 lbs./acre and L.F.N. was used at 1, 3/4, 1/2, 1/4 and 0 lbs./acre. No consistent significant reduction or increase in yield, test weight or height of plant was noted for any of the above treatments. (Contrib. N.D. Agric. Exp. Sta.).

Reaction of several spring wheats sprayed with three formulations of 2,4-D at tillering. Helgeson, E. A. The bread wheats, Thatcher, Mida, Regent, Rival and Pilot, and durum wheats, Mindum and Carleton, were sprayed with aqueous solutions of sodium salt, alkanolamine, and butyl ester formulations of 2,4-D at 1 lb. acid equivalent per acre when fully tillered. Plots were cultivated to control weeds, replicated 4 times and randomized. With the exception of the ester formulation, no marked consistent reduction in yield, height of plant or test weight of grain was apparent. Ester sprays reduced the average height of all varieties from 2 to 3 inches, the average yield of all varieties by 4 bushels and caused a slight reduction in average test weight. There seemed to be no consistent difference between varieties. (Contrib. N. D. Agric. Exp. Sta.).

Effect of 2,4-D (butyl ester) on wheat and barley when applied at different stages of growth. Olson, P. J., Breakey, W. J. and Brown, D. A. Amine and ester of 2,4-D were applied to barley and wheat at 12 ounces per acre at Winnipeg, and to barley and wheat at Brandon and Mordon respectively at 8 ounces per acre. The first application was made after seeding but before emergence, and the successive treatments at approximately 3 day intervals until 23 treatments had been applied at Winnipeg, 15 at Mordon and 19 at Brandon. There were two critical periods in the case of each crop when significant to highly severe damage was done as measured by reduction in yield in both crops. One of these was an early period when the plants were from 1 to 5 inches tall, and the other a later period which in wheat occurred when the plants were 16 or 17 inches tall and 11 or 12 days before heading, and in barley about 3 to 6 days before heading. Yield reduction at these two rather narrow periods was very sharp as compared with the immediately preceding and immediately following treatments. Between these periods little or no damage was done. (Contribution from Division of Plant Science, The University of Manitoba, and the Dominion Experimental Stations at Mordon and Brandon.)

Response of varieties of wheat, oats and barley to 2,4-D. Olson, P. J. and W. J. Breakey. Ester and amine were applied to Thatcher, Redman, Regent and Carleton wheat at Mordon; to Thatcher, Redman and Stewart wheat; to Ajax, Exeter and Vanguard oats, and to Montcalm, O.A.C. and Vantage barley at Winnipeg. The rates used at Mordon were 4 and 8 ounces acid per acre for ester and 6 and 12 ounces for amine. The treatment was applied June 9th when all varieties were about 11 inches tall. At Winnipeg 4 and 8 ounces of each of ester and amine were used, and the treatments were applied June 2 and 24 to wheat and barley and June 4 and 28 to oats. The crops were 10 to 11 inches high at the first date. At the second date they ranged from 2 to 11 days before heading. (Stewart Durum 11 days before heading). The greatest damage was suffered by oats. The ester treatments on June 4 reduced the yields of Ajax and Vanguard by about 40%. Amine did much less damage than ester although the 8 oz. rate reduced yield severely. The heavier rate did the greater damage in the case of both formulations. Relatively little damage was done to barley at either date although the reduction in yield under the ester treatment was significant throughout in the case of Montcalm, and for the ester treatments at both dates in the case of O.A.C. There were no consistent differences between rates. Wheat also

showed slight or no damage in most cases. Yields of Regent were reduced slightly though significantly for all treatments at Morden. Redman and Stewart showed some reduction under the first treatment and Stewart under the second treatment at Winnipeg. There were no consistent differences between ester and amine or between rates. (Contribution from Division of Plant Science, The University of Manitoba, and Dominion Exp. Station, Morden.)

Response of spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 6 oz./a. rates, 1949. Thomas K. Pavlychenko. Quadruplicate plots of Spring wheat, oats, barley, rye and flax, all with alternating checks, were treated with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D) and ACP 638, 472 (acid of 2,4-D), ACP 646, 649, 675 and 648 (all 2,4-D non-commercial formulations) at 6 lbs./a. rate. Prevailing weeds were Stinkweed (Thlaspi arvense), Russian thistle (Salsola Kali), Wild buckwheat (Polygonum convolvulus), Red-root pigweed (Amaranthus retroflexus) and other amaranths. The soil was silt-clay loam. A heavy infestation of grasshoppers in June and July caused damage to the crops and somewhat distorted their yields. Results: At 6 oz./a. rate most of the chemicals have reached, or in some cases passed, the point of crop tolerance. Consequently, some spectacular evidence of injuries were observed. Weedar 64 in oil caused a reduction in yield and serious delay of flax, depressed oats and somewhat retarded wheat and barley. ACP 649 caused blasted florets in oats, depressed flax and retarded other crops. ACP 675 was very severe on flax. ACP 646 depressed barley and flax but was still tolerant to other crops. ACP 658 and 472 were tolerant to all crops. The susceptible weeds were very effectively controlled by most chemicals. Russian thistle was only strongly depressed but not killed by ACP 638, 646, 675 and 472 but was practically eliminated by other chemicals. Wild Buckwheat and Amaranthus sps. were only occasionally killed by Weedar 64 in oil or ACP 649, although they were considerably depressed in decreasing order by Weedar 64, 1 pt., 1 qt., 2 qts. oil, ACP 649, Weedone Concentrate 48, Weedar 64 in water, ACP 646, 648, 638, 472 and 675. Agroxone was quite tolerant to all crops, effective on Stinkweed and fully ineffective on the other weeds. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Response of Spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 8 oz./a. rates, 1949. Thomas K. Pavlychenko. The four Spring grain crops, wheat, oats, barley and rye, and flax, were treated in quadruplicate plots with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), Agroxone (2 methyl o chlorophenoxyacetic acid), ACP 638, 472 (acid of 2,4-D), ACP 646, 648, 649 and 675 (all non-commercial formulations of 2,4-D) at 8 oz./a. rates. The most important weeds present wereL Stinkweed (Thlaspi arvense), Russian thistle (Salsola Kali), Wild Buckwheat (Polygonum convolvulus), red-root pigweed (amaranthus retroflexus) and other amaranths. Soil was a silt-clay loam. Results: At 8 oz./a. rate only Weedar 64 in water and ACP 472 were clearly beneficial to flax and to all grain crops. They both killed approximately 80%, and seriously depressed the remaining weeds. ACP 638 and 646 gave reasonably good control of weeds. The grain crops

were not seriously depressed but the flax sustained significant injury. Agroxone eliminated stinkweed but permitted Russian thistle to produce seed. All the crops were not injured. ACP 649 was very hard on oats and flax, somewhat depressed height of wheat and barley but their yields were much higher than in checks due to very complete elimination of the weeds. Weedone Concentrate 48 depressed height of all the crops excepting rye, but the yields were equal to or slightly higher then in checks in all cases. Weedar 64 in oil was very effective in destroying weeds but it often caused reduction in the yield of oats, barley, rye and particularly flax. ACP 675 gave incomplete control of weeds and ruined the flax. ACP 472 produced satisfactory yet incomplete control of weeds but was very tolerant to crops, including flax. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Response of Spring grain crops and flax treated 24 days after emergence with different systemic herbicides. Thomas K. Pavlychenko. Spring wheat, oats, barley, rye and flax were treated at 2 oz./a rates with ACP 638, 472 (both 2,4-D acid), ACP 646, 649, 675, 648 (various formulations of 2,4-D) Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D) and Agroxone (2 methyl 4 chlorophenoxy-acetic acid). Quadruplicate treatments were made on all crops grown on a silt-clay loam soil at Saskatoon, Sask. The principal weeds were stinkweed (Thlaspi arvense), Russian thistle (Salsola Kali), Wild buckwheat (Polygonum convolvulus), Red-root pigweed (Amaranthus retroflexus) and some other amaranths. Extremely heavy infestation of grasshoppers in June and July has caused some distortion to grain yields, particularly wheat and barley. Results: At 2 oz./a. rate all the chemicals used were sufficiently tolerant to the crops, including flax, to cause serious retardation in their development. Of them all, Agroxone was the most tolerant to crops. It was effective on young stinkweed but failed to control older plants and was altogether ineffective on Russian thistle, buckwheat and the amaranthus sp. ACP 649 was the most effective on the weeds but it also depressed crops, particularly flax and oats. Of the other chemicals, Weedar 64 in oil was extremely severe on weeds but it also depressed the grain crops and flax. ACP 648 showed consistently a high selectivity for Russian thistle. ACP 638 and ACP 472, acid of 2,4-D, showed considerable tolerance to crops, but they were somewhat weaker on weeds than either Weedone Concentrate 48 or Weedar 64. Weedar 64 in oil, ACP 675 and ACP 646 were all hard on flax in the order stated. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

Response of Spring grain crops and flax treated 24 days after emergence with different systemic herbicides at 4 oz./a. rates, 1949. Thomas K. Pavlychenko. Quadruplicate plots of Spring wheat, oats, barley, rye and flax were treated with ACP 638, ACP 472 (both acid of 2,4-D), Weedone Concentrate 48, (ethyl ester of 2,4-D) Weedar 64, (amine salt of 2,4-D) Agroxone, (2 methyl 4 chlorophenoxyacetic acid) ACP 646, 648, 649 and 675 (all 2,4-D non-commercial formulations) at 4 oz./a. rates. The prevailing weeds were: stinkweed (Thlaspi arvense), Russian thistle (Salsola Kali), wild buckwheat (Polygonum convolvulus), Red-root pigweed (Amaranthus retroflexus) and some other amaranths. The soil was silt-clay loam. In June and July a heavy infestation of grasshoppers caused some damage, particularly to wheat and barley plots, and distorted the yield results. Results: At 4 oz./a. rates Weedar 64 in oil, ACP 649 and 675 noticeably depressed

Flax, wheat and oats, were easier on barley and rye. Agroxone was very tolerant to all crops but ineffective on weeds excepting young stinkweed. ACP 648 depressed Russian thistle as much as ACP 649 or more, yet was quite tolerant on crops. ACP 638 and 472 were both easy on crops but also less effective on weeds than either Weedone Concentrate 48 or Weedar 64 in water. ACP 646 did not harm grain crops, was much harder on flax, but did not give any outstanding results with weeds. ACP 649 caused some blasting in oats. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

Response of Spring grain crops treated near the boot stage with different systemic herbicides, 1949. Thomas K. Pavlychenko. Wheat, oats, barley and rye approaching the boot and flax the bud stage were treated in quadruplicate plots with Weedone Concentrate 48 (ethyl ester of 2,4-D), Weedar 64 (amine salt of 2,4-D), agroxone (2 methyl 4 chlorophenoxyacetic acid), ACP 638, 472 (acid of 2,4-D, ACP 638, 646, 649, 648 and 675 (all form. of 2,4-D) at rates of 2, 4, 6 and 8 oz./a. Stinkweed (Thlaspi arvense), Russian thistle (Salsola Kali), Wild buckwheat (Polygonum convolvulus) and Red-root pigweed (Amaranthus retroflexus) were the main weeds. Wheat and flax were ruined by grasshopper damage and yields were not taken. The weeds were far advanced and showed considerable resistance even to higher rates of some of the chemicals. Results: In general, crops at this stage were more sensitive to the chemicals than if treated earlier or after the bloom stage. The injurious effects were manifested both by depressed height and yields. Yields, however, were inconsistent in many cases due to grasshopper damage. Nevertheless, the effects of various chemicals were clearly shown. Weedar 64 in oil was hard on all crops, particularly at 6 or more oz./a. rates. Weedar 64 in water and Weedone Concentrate 48 depressed the crops at 6 and 8 oz./a. rates but gave a good control of the weeds. ACP 638 gave some increase in yield of all three crops but failed to produce complete kill of weeds at any rate. Agroxone was very erratic on account of poor weed kill. ACP 675 was very poor as weed killer at this stage. ACP 648 gave a satisfactory kill of weeds but also depressed crops considerably. ACP 472 retarded the weeds but was beneficial to crops, especially at the higher rates. ACP 649 was very hard on oats and barley, particularly at 6 and 8 oz./a. rates. (Contri. Agr. Div. American Chemical Paint Company, Saskatoon, Sask.)

Effects of 2,4-D applied to weed infested spring wheat at 5 different growth stages. Soxsmith, J.J. Quadruplicate plots of Rescue wheat, containing an extremely heavy infestation of Russian thistle, were treated with triethanolamine 2,4-D at 4 and 8 oz. per acre and butyl ester 2,4-D at 2, 4, and 8 oz. per acre at five growth stages. First treatments were given when the wheat was in the three-leaf stage and the Russian thistles were 1 in. tall in "pine-leaf" stage. Other treatments were given at weekly intervals, the fifth treatment being applied 29 days after the first treatment, when wheat was in late shot blade to early boot stage and Russian thistle up to $2\frac{1}{2}$ in. tall with definitely formed side branches. Dry weather and heavy infestation had delayed weed development. Weed control increased with increased rates of both amine and ester, and decreased with delay in time of treatment. Very satisfactory control was obtained with all 2,4-D applications given at first stage, and with all but the ester 2 oz. at second stage. None of the applications given at third, fourth, or fifth stage were considered satisfactory. Malformations

of all types increased with increase in dosage rates, being more numerous and more severe from ester applications. Such malformations were pronounced only at first growth stage. Floret sterility was greatest from fourth stage treatments (wheat coming to shot blade). Yields were significantly higher only from amine 8 oz. treatments, even though all but ester 8 oz. yields were equal to or greater than check yields. Fourth and fifth stage treatment yields were significantly lower than yields at other stages. (Contribution of Dominion Experimental Station, Lethbridge, Alberta)

Effects of 2,4-D applied to weed infested spring barley at 5 different growth stages. Soxsmith, J. J. Quadruplicate plots of Compana barley, containing an extremely heavy infestation of Russian thistle, were treated with triethanolamine 2,4-D at 4 and 8 oz. per acre and butyl ester 2,4-D at 2, 4, and 8 oz. per acre at five growth stages. First treatments were given when the barley was in the three-leaf stage and the Russian thistles were 1 in. tall in the "pine-leaf" stage. Other treatments were given at weekly intervals, the fifth treatment being applied 29 days after the first treatment, when barley was in late boot (few boards showing) and Russian thistle up to 2½ in. tall with definitely formed side branches. Dry weather and heavy infestation had delayed weed development. Weed control increased with increased rates of both amine and ester, and decreased with delay in time of treatment. Very satisfactory control was obtained with all 2,4-D applications given at first stage, and with all but the ester 2 oz. at second stage. None of the applications given at third, fourth, or fifth stage were considered satisfactory. Malformations of all types in barley heads increased with dosage rate and were more severe from ester treatment, being pronounced only for first stage treatments. Floret sterility was greatest from fourth stage treatments (barley to shot blade). Because of poor growing conditions and erratic stands, no significant yield differences were obtained. However, average yields for all rates were greater than check yields, and yields from second stage treatments were higher than from other four stages. (Contr. of Dom. Exp. Station, Lethbridge, Alberta)

Effects of 2,4-D on weed-free Nemaha oats. Shafer, Neal E. Four rates of 2,4-D ester and three rates of 2,4-D amine salt were sprayed on hand-weeded Nemaha oats at four different stages of growth. Rates used were isopropyl ester at 1/8 pound, 1/4 pound, 1/2 pound, and 1 pound per acre, and the amine salt at 1/2 pound, 3/4 pound, and 1 pound per acre. The oats were sprayed in the jointing, early boot, late boot, and flowering stages of growth. At rates of 1/4 pound and above, the ester gave significant reductions in yield when applied at the jointing stage of the oats. The number of florets per plant, florets per panicle, and 1000 kernel weight varied inversely with the different rates of ester but varied directly with the three rates of amine salt used. No significant differences due to treatment were found in the other three stages of growth. Where noted, reductions in yield due to 2,4-D treatment appeared to result from a reduction in the number of flowering culms produced per plant, reduction in the number of florets per panicle, and a reduction in the weight of 1000 kernels. Consistent, though not significant, increases in yield were obtained from all rates of both amine and ester on the late boot and flowering stages of growth with the exception

of the 1/2 pound ester applied at the late boot stage. (Contribution of the Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska.)

The effect of 2,4-D on Clinton 59 oats. Shaw, W. C. and C. J. Willard. The triethanol amine salt and the butyl ester of 2,4-D were applied to Clinton 59 oats at 8 stages from the two-leaf stage to the late milk stage at 0, 1/4, 1/2, 1, 2, and 4 pounds per acre, 4 replications of each treatment in a randomized split plot design. The least injury was produced at the 4-leaf stage and the early and late milk stages. The greatest injury was at the 2-leaf stage, (26 days after planting), when all rates above 1/4 pound produced highly significant injury. Aside from this date, 1/4 and 1/2 pound produced only slight losses at any date, the average of all dates indicating a loss of 3.6 and 3.1 bushels respectively, which is barely significant. The ester caused greater losses than the amine at corresponding rates, the difference of 4.1 bushels as an average of all stages and all rates being highly significant. The injury increased as the rate of application increased, but not in direct proportion. Protein analyses of grain from last year's similar test, (Abstract III - 7, Research Reports NCWCC, 1948) suggested that, as with wheat, the percentage of protein in the grain was not affected in this 1948 test. (1949 samples not yet germinated or analyzed.) (Contribution from Ohio Agricultural Experiment Station.)

Varietal differences in the effect of 2,4-D on oats. Shaw, W.C. and C. J. Willard. Four important Ohio varieties of oats, Clinton, Mindo, Ajax, and Columbia, were treated with an ester of 2,4-D at 1/2, 1, 2, and 4 pounds per acre at the 2-leaf, early joint, and heading stages of growth, 3 replications, in a randomized split-split plot design. There were significant differences in the reactions of the varieties at all stages. The same varieties were similarly treated last year in a small, less well-planned test, and the ranking then was not the same as this year, suggesting a seasonal interaction. The largest differences were at rates beyond those recommended for weed control, though there were differences even at 1/2 pound. The order of injury, as an average of all rates and dates, from least to greatest, was Columbia, Ajax, Clinton, and Mindo. (Contribution from Ohio Agricultural Experiment Station.)

The effect of 2,4-D on clovers and alfalfa sown in small grain. Shaw, W. C. and C. J. Willard. A mixture of alfalfa, 6 pounds, red clover, 4 pounds, and Ladino clover, 1 pound, was sown on March 8 in Thorne wheat and on April 12 in Clinton 59 oats which were treated at 10 and 9 stages, respectively, (including pre-emergence in each grain) with the amine salt and the butyl ester of 2,4-D at 0, 1/4, 1/2, 1, 2, and 4 pounds per acre at each stage, four replications of each rate. Perfect stands of legumes were obtained after all fall treatments of wheat. Most of the stands in oats following pre-emergence treatments were fair, though somewhat less than the checks. Slightly better than half stands, mostly Ladino, were obtained following about half the spring treatments of 1/4 or 1/2 pound, mostly at the very advanced stages of maturity (late joint and later, after the more practical stages of treatment). Legume stands were usually practical failures in wheat and oats treated at the recommended stages for weed control.

Whenever there was a legume stand remaining, weed control was likewise imperfect. There was no alfalfa on any treated plot, and only a little red clover. While it is obvious that partial stands of legumes may remain after treating small grains with 2,4-D at late stages, we cannot recommend treating small grain in which legumes are sown with 2,4-D. (Contribution from Ohio Agri. Expt. Station.)

Effect of 2,4-D on Clinton oats in northern Illinois. Slife, F. W. and Fuelleman, R. F. Clinton oats were treated May 24, 1949, with 1/4, 1/2 and 3/4 of a pound of 2,4-D acid per acre in the ester form. The oats were fully tillered and the stems had not begun to joint. The check plot yielded 69 bushels per acre and the treated plots yielded 64 at the 1/4 pound rate, 52 at the 1/2 pound rate, and 50 at the 3/4 pound rate. In all treated plots there was some reduction in the height of oat plants, evidence of sterile spikelets, bending of the stems near the ground, and a decrease in the size of the root system. The effects were less evident on the 1/4 pound plots. Fully tillered Clinton 11 oats were treated May 11 at Urbana, for the control of field bindweed. Three-fourths pound of 2,4-D acid per acre was used in the amine form. The yield in the treated area was 35 per cent lower than the check area. The plants were stunted by the treatment and matured approximately one week later than the untreated area. There were many sterile spikelets and much lodging. The lodging may have been caused by the decrease in the size of the root system which was very evident in the treated area. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

The effect of selective herbicides on spring planted oats seeded to red clover. Taylor, D. K. Treatments involving low volume applications of the ester of 2,4-D at 2, 4, 6 and 8 ounces of acid per acre, 1-2/3 and 2-1/2 quarts of Dow Selective in 75 gallons per acre and calcium cyanamide at 100 pounds per acre were applied to plots of Victory oats seeded to red clover. All treatments, replicated three times, were made when the oats were 10 - 11 inches in height and the red clover plants were in the four leaf stage. Although lower in yield, the 2,4-D treatments were not significantly lower than the check plots. The yields of the Dow Selective treatments were equal to the check while the calcium cyanamide treatment gave a significantly higher yield owing chiefly to the added nitrogen. A count of the red clover populations at harvest showed a significant reduction from the check for all treatments except 2,4-D at 2 ounces and Dow Selective at 1-2/3 quarts per acre. The per cent. survival ranged from 92.7 to 21.8 as the rate of application of 2,4-D increased from 2 to 8 ounces, 88.6 to 56.4 per cent. for the Dow Selective treatments, and 69.5 per cent. for the calcium cyanamide treatment. The control of such weeds as lady's thumb (Polygonum Persicaria) and corn spurrey (Spergula arvensis) was not promising in any of the treatments, while barnyard grass (Echinochloa crusgalli) provided strong competition in all plots. (Contribution of the Dominion Experimental Farm, Agassiz, B. C.)

Response of six spring wheat varieties to 2,4-D. Wardon, Robert L. and Bullotte, J. W. Pilot, Thatcher, Ceres, Rescue and Supreme hard red wheats and Onas, a white variety were treated with the butyl ester of 2,4-D at 0, 1/3, 2/3, 1 lbs. acid equivalent at

the early tillering and full tiller stage in 1948. Weeds were controlled mechanically so that yield differences within varieties were due to treatment and not to differential weed control. The test included three replications designed for a split plot analysis of variance. 2,4-D at the early date caused severe head deformities regardless of variety and rate although this condition was less noticeable on the awnletted and awnless varieties. Protein analysis revealed a highly significant increase with increased rates of 2,4-D although the maximum difference between high and low was only .86 per cent. Naturally occurring protein differences between varieties were significant but the effect of rates on varieties and dates on varieties were not significant, indicating that the varietal response was similar for these factors. No differences in protein were attributable to dates of 2,4-D application. Significant yield differences were noted between varieties, rates of 2,4-D and the effect of dates of application between varieties. It was not possible to compare yields of varieties directly because of inherent yield differences. As a result, the possible differential varietal response had to be measured on the basis of the date x variety and rate x variety interactions of which the former was significant. Thatcher and Pilot yielded more at the early date of treatment while the others yielded less. Rates of 2,4-D decreased bushel yields progressively as follows: 0 lbs, 30.3; 1/3 lbs, 29.2; 2/3 lbs., 27.6; and 1 lb., 27.2. Correlation between yields and protein content was - .7485 which is highly significant and indicates that protein increases brought about by 2,4-D were accompanied by decreased grain yields. (Contribution of the Agronomy and Soils Dept., Montana Agricultural Experiment Station in cooperation with the Sherwin-Williams Company).

Project IV. Pre-emergence Treatments With Herbicides in Field and Truck Crops

Corn and Sorghum — Investigation leader: R. F. Fuelleman

Summary

The number of abstracts received prior to the preparation of this summary is too small to permit the drawing of definite conclusions for the entire region. In some areas data pertaining to pre-emergence treatments of corn were not tabulated because harvest of the crop was not completed. This is true of the fields at the Dixon Springs Station in southern Illinois. No abstracts on sorghum were received.

From the evidence shown in the abstracts of 1948, it was obvious that successful pre-emergence treatments of weeds in corn were particularly dependent upon soil types and soil moisture conditions at the time of treatment. Certainly the data for 1949 have not greatly changed this conclusion. Where moisture was sufficient to bring about germination of both corn and weeds, control of weeds was good. Where rainfall was insufficient for immediate germination little or no control of weeds was obtained. Check plots without cultivation or chemical treatments produced low yields. Most of the abstracts indicated that pre-emergence treatment alone, where weeds were prevalent, gave significantly lower yields than where chemicals were combined with one or more cultivations. Most of the reports showed that good control of broadleaved weed species was obtained, but only poor control of grass weeds. 2,4-D was more effective than other chemicals, altho PCP, DN-289, and other materials gave good control. Although the heavier rates of application of 2,4-D gave better control than low and medium rates, 2 pounds of 2,4-D gave almost as good control as 3 or 4 pounds, and did not affect the yield of corn as much as the heavier rates.

A single cultivation as compared to one cultivation plus pre-emergence application of 2,4-D gave significantly lower yields of corn. Three cultivations plus 2,4-D did not give significantly higher yields than three cultivations alone. Where only one cultivation of corn was possible, as occurred in some areas, because of excessive moisture, pre-emergence treatment was effective in reducing weed populations and increasing corn yields.

Pre-emergence plus post-emergence treatments with 2,4-D at 1 and 2 pound rates gave larger yields where no cultivation was used, however, pre- and post-emergence treatments plus cultivation did not increase yields over either pre-emergence or post-emergence treatments alone with cultivation. Briefly either post-emergence or pre-emergence treatments with 2,4-D plus cultivation gave similar yields of corn.

An experiment was conducted at the Illinois Experiment Station with pre-emergence treatments of corn and soybeans, watered by irrigation immediately after the chemical was applied. All of the corn and soybeans were destroyed before they emerged or died shortly after emergence.

Little or no difference was indicated in the results obtained between the amine and ester forms of 2,4-D.

Abstracts of Results of Cooperators

The Effect of Pre- and Post-emergence 2,4-D on Corn. Aldrich, R. J. and C. J. Willard. Indiana 750 was planted April 27, 1949, on Fox silt loam at Chillicothe. The experimental design was a split-split plot design with three replications. Plots were 2 x 12 hills in size with 2 x 10 hills harvested for yield. Four cultivation practices were used--no cultivation, scraped and hoed, one cultivation, and three cultivations. One, two, and four pounds of the butyl ester of 2,4-D were applied pre-emergence May 2. One fourth, one half, one, and two pounds of the butyl ester were applied post-emergence two days after the corn was laid by. Drop booms were used in making post-emergence applications. Two pounds 2,4-D pre-emergence gave good control of weeds with one pound slightly less effective and four pounds slightly more effective. All post-emergence rates gave effective weed control, but there was an indication that one and two pounds post-emergence gave pre-emergence control of late germinating weeds. Yields from uncultivated, untreated checks were approximately 1/3 as great as yields from untreated plots cultivated three times. Yields from untreated plots scraped and hoed and plots cultivated once were approximately 3/4 as great as yields from untreated plots cultivated three times. There was no significant difference in yields between untreated plots scraped and hoed and untreated plots cultivated once. 2,4-D in any combination did not increase or decrease the yields of plots cultivated three times. All pre- and post-emergence 2,4-D and all combinations of pre- and post-emergence on scraped and hoed plots and on plots cultivated once gave yields equal to plots cultivated three times. No 2,4-D treatments increased yields of uncultivated plots equal to yields of plots cultivated three times, but combinations of pre- and post-emergence gave higher yields, probably significantly, than any single 2,4-D treatment. (Contribution of the Ohio Experiment Station)

The Effect of Pre-emergence 2,4-D on Corn. Aldrich, R. J. and C. J. Willard. Iowa 939 was planted at the rate of 4 seeds per hill, May 31, 1949, at Columbus on a Miami-Brookston complex soil. Experimental design was a split-split-split plot with three replications. Plots were 2 x 11 hills in size with data taken on 2 x 10 hills. There were not enough weeds to affect the corn. Four cultivation practices were used--no cultivation, hand hoed, one cultivation, and three cultivations. Corn was planted at two depths--shallow (1 1/2") and deep (3 1/2"). One, two, and four pounds of the amine salt of 2,4-D were applied on three dates--day of planting, four days after planting, and seven days after planting. All the corn had emerged at the time the last treatment was made. Plants in strips receiving one cultivation were measured (tips of extended leaf) July 8. There was no significant difference in height of plants from treated plots between the two depths of planting. There was no difference in height of plants between untreated plots and plots treated with one pound. Plants from plots treated with two and four pounds averaged six and ten inches shorter, respectively, than untreated plots. There was no difference in height of plants between plots treated on the day of planting and plots treated four days after planting. Height of plants from plots treated seven days after planting was greater, but probably not significantly, than height of plants from earlier treatments. Stand was decreased, probably significantly, by two and four pounds of 2,4-D applied on the day of planting and four days after planting. There was no reduction in stand from one pound of 2,4-D on any date, nor from any rate of 2,4-D when applied seven days after planting. There was no difference in stand of treated plots between the two depths of planting. Yield data are not yet available. (Contribution of the Ohio Experiment Station)

The Effect of Pre-emergence Chemicals on Corn. Aldrich, R. J. and C. J. Willard. Indiana 750 planted May 11, 1949, at Piketon, Ohio, was treated May 17, 1949. Soil type was Scioto river bottom Genesee silt loam. The experimental design was a split plot with three replications. Plots were 2 x 12 hills in size with 2 x 10 hills harvested for yield. Four cultivation practices were used--no cultivation, scraped and hand hoed, one cultivation at lay-by, and three cultivations. One, two and four pounds per acre of the amine salt and butyl ester formulations of 2,4-D and four, eight, and sixteen pounds per acre of XP-40 (Sherwin-Williams) were used as pre-emergence treatments on each cultivation practice. Principal weeds were morning glory, hedge bindweed, nut grass and wild cucumber. There was no visible difference in weed control between the two 2,4-D formulations. Two pounds of 2,4-D gave excellent control of all weeds except nut grass. Four pounds of 2,4-D gave some control of nut grass. One pound of 2,4-D gave good control of annual morning glory and some control of hedge bindweed and wild cucumber. There was no observable weed control from any XP-40 treatments. The yields of corn were not decreased by any 2,4-D treatments. The yields from uncultivated, untreated checks and uncultivated plots treated with XP-40 were lower, but probably not significantly lower, than all other yields. There were no other differences between yields. (Contribution of the Ohio Experiment Station)

The Effect of Five Chemicals Applied Pre-emergence on Corn. Aldrich, R. J. and C. J. Willard. Iowa 939 was planted May 18, 1949, at Columbus on Brookston silt loam. The experimental design was a randomized block with three replications. Plots were 2 x 10 hills in size. The following treatments were made May 21 (pounds active ingredient per acre): XP-40 (Sherwin Williams) 4, 8, 12, 16, and 24 pounds, pentachlorophenol (40 percent Dow Concentrate) 4, 8, and 12 pounds, DN-289 (Dow) 2, 4, and 8 pounds, finely divided 2,4-D acid (Dow) 2 and 4 pounds, and amine salt of 2,4-D, 1 1/2 pounds. A heavy rain fell within thirty minutes after the chemicals were applied. The predominant weeds were crabgrass, foxtail, pigweed and lamb's quarter, but there were not enough weeds to affect the yield of corn. Both 2,4-D compounds gave complete control of all weeds. PCP at 8 and 12 pounds per acre and DN-289 at 4 and 8 pounds per acre also gave good weed control. There was no indication of any weed control from any XP-40 treatments. Plants in all plots treated with 2,4-D showed typical 2,4-D affects shortly after emergence. There was no significant differences between the yields from the different treatments. (Contribution of the Ohio Experiment Station)

RESPONSE of Corn to Pre-emergence Applications of 2,4-D. Lee, Oliver C. Replicated plots of corn (Ind. hybrid 844) were treated with 1 1/2 and 2 pounds of 2,4-D acid per acre as a pre-emergent spray, on both Brookston and Crosby silt loams. These rates of application did not affect the corn. No symptoms of injury were noted at any time during the season. Yield of corn on the Brookston silt loam were: for checks, 83.2 bushels; 1 1/2 pound treatment, 84.0 bushels; and where 2 pounds were applied, 88.1 bushels. On the Crosby silt loam yields were: 83.8, 82.0 and 81.2 for the 1 1/2, 2 and checks respectively. Weeds were held in check for a period of from 3 to 5 weeks. Some degree of grass control was noted. All areas were cultivated six weeks after planting. Weeds were removed from check plots by hoeing and pulling. Conditions apparently were ideal for pre-emergence treatments; moisture was adequate and temperature so as to bring about rapid germination of weed seeds. Applications of 1 1/2 pounds of 2,4-D acid checked the growth of such perennials as perennial morning glory and wild sweet potato, as well as annuals. Experiments in other locations of the state where conditions were dry did not prove satisfactory. (Contribution of the Department of Botany and Plant Pathology, Agri. Exp. Sta., Purdue University)

Effect of Pre-emergence Treatments on Ensilage Corn (Canada 355). Leggett, H. W. The plots were treated with 75, 150, and 300 pounds per acre of cyanamid and 1, 2, and 3 pounds acid per acre of the triethanolamine salt of 2,4-D. The treatments were made 6, 9 and 12 days after seeding. Square yard weed counts were made on each plot and the corn from each square rod plot was weighed and calculated in tons per acre. Weather conditions were very poor for this type of experiment as we had only .85 inches precipitation in June and .5 inches from July 1st to 15th. Two square yard weed counts were taken, one in June and one after the heavy precipitation in late July. The corn while showing some onion leaf and slight brace root distortions showed no significant yield increases or decreases from any of the treatments. The weed counts while showing a slight tendency to decrease as the rates increased showed no significant decreases between treatments and stages when compared with the check plots. While the results of previous years' work do indicate some pre-emergence control with 2,4-D formulations our experience has been that it is not a practice that can be recommended. (Contribution of Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada)

Pre-emergence vs. Selective Weed Control in Sweet Corn. Sexsmith, J. J. Quadruplicate plots of Golden Early Market sweet corn, seeded on May 12, 1949, were pre-emergence treated with triethanolamine 2,4-D at 3/4 and 1 1/2 pound per acre on May 12. For comparison, quadruplicate plots were given selective 2,4-D treatments with the three types of the chemical at varying rates on June 28 when the corn was 8 to 12 inches tall, and other plots were treated on July 5 when the corn was 10 to 18 inches tall. Pre-emergence treatment with amine 2,4-D at 3/4 pound gave 90 percent control of red-root pigweed and lambs' quarters, while the 1 1/2 pound rate gave a 95 to 98 percent control. The best control obtained from any of the selective treatments was poor by comparison, and could not be considered economically feasible. The pre-emergence treatments caused some reduction in vigour of corn growth during the early part of the season, but this lack of vigour was completely overcome by harvest time. In another test, treated May 26, where several chemicals were used for pre-emergence weed control, neither the amine or ester 2,4-D at the 3/4 and 1 1/2 pound rates gave equal results. As no reason for this difference in weed control could be ascertained, we should not expect to obtain 95 percent control of weeds from all pre-emergence applications of 2,4-D. (Contribution of the Dominion Experimental Station, Lethbridge, Alberta)

Cultivation and Chemicals for Weed Control in Corn. Shaw, W. C., W. H. Johnson, H. M. Gitlin, and C. J. Willard. This experiment consisted of four replications in a randomized block design. The plots consisted of six 40 inch rows of corn 270 feet long, of which the two center rows were harvested. The treatments and yields per acre were as follows: (1) No cultivation or chemicals applied, 15.8 bushels; (2) Three standard cultivations with sweep shovels, 27.0 bushels; (3) Same as (2) except scrapers (Russell shovels) next to row, 27.2 bushels; (4) Two standard cultivations with 2 pounds 2,4-D per acre at lay-by, 29.6 bushels; (5) Pre-emergence treatment with 2 pounds 2,4-D per acre and one cultivation when weeds appeared, 26.5 bushels; (6) Pre-emergence treatment with 2 pounds 2,4-D per acre, 1/2 pound 2,4-D post-emergence when weeds appeared, no cultivation, 27.3 bushels per acre; (7) Pre-emergence treatment with 2 pounds 2,4-D per acre, no post-emergence treatment and no cultivation, 24.1 bushels per acre. None of the differences, except with treatment (1), are significant. (Contribution of the Ohio Experiment Station)

Chemicals for Pre-emergence Weed Control in Corn. Slife, F. W. and R. F. Fuelleman. The following chemicals were applied as a pre-emergence spray on corn. Amine of

2,4-D, 1, 2, and 3 pounds acid per acre; ester of 2,4-D, 1, 2, and 3 pounds acid per acre; TCA 10, 20, and 30 pounds acid per acre; pentachlorophenol in oil 2, 4, and 6 pounds acid per acre; amine salt of 4-chloro-2-toloxyacetic acid 1, 2, and 3 pounds acid per acre; contact dinitro 1 1/3, 3, and 4 1/2 pounds per acre; and granular cyanamid 150, 300, and 600 pounds per acre. Chemicals were applied 2 days after planting. The soil was a black silt loam which was relatively dry at the time of application. Corn emerged on all plots 6 days after planting with no visible symptoms of injury. Rain fell 10 days after planting the corn, and within one week after this date the corn had died on all the TCA plots. Rainfall was above normal during the season at this location. Weed control was excellent on all plots with the amine of 2,4-D, ester of 2,4-D, amine of 4-chloro-2-toloxyacetic acid, and the contact dinitro. Weed control was good with the cyanamid at 300 and 600 pound rates for 2 weeks, after which the weed infestation was thicker in the cyanamid plots than in the check plots. Although TCA killed the corn it gave good weed control for 2 weeks after which it apparently had decomposed and allowed weeds to grow. Pentachlorophenol in oil gave good weed control for 2 weeks, but did not seem to have enough residual effect to prevent weed germination after this period. There was no stand reduction of corn on any plots due to treatment, but plant height was slightly reduced and yields lowered at the 3 pound rates of the amine and ester of 2,4-D and the 3 pound rate of amine of 4-chloro-2-toloxyacetic acid. Treatment plus one cultivation at lay-by stage gave slightly higher yields of corn than treatment without cultivation. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois)

Effect of Rainfall Immediately After Pre-emergence Treatment on Corn With 2,4-D. Slife, F. W. and R. F. Fuelleman. Small plots of corn and soybeans were treated with 2 pounds of 2,4-D acid in the amine form immediately after planting and then watered to simulate rainfall. Water was applied at 3 rates to compare to a moderate rain, heavy rain, and extra heavy rain. The soybeans were killed on all plots. The corn was killed on the 2 heavily watered plots, but emerged on the moderate rainfall plot. The corn on this latter plot was stunted and malformed and within 10 days after emergence all plants died. The soil was a black clay loam and the plots were watered just as fast as the soil would absorb the water without runoff. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois)

Pre-emergence Weeding in Field Corn. Staniforth, D. W. and A. L. Bakke. Pre-emergence treatments were made in an area of double-cross hybrid, 2 days after seeding. Plots consisted of a sprayed strip, 2 feet wide, centered on a 30 foot row. Guard rows were provided. Cultivation was delayed until the corn was 6-8 inches tall, weed counts made at that time, and normal cultivation carried on. In one test the triethylamine salt, the butyl ester and the micronized acid of 2,4-D were applied at 0, 1, 2, and 4 pounds acid equivalent per acre. There were no differences in degree of weed control or in yield of corn among the three formulations. Weed control was best at the 4 pound rate and good at the 2 pound rate. The 1 pound rate did not give adequate weed control. The 2 and 4 pound per acre rates reduced crop stand and yield, but the differences were not significantly lower by statistical measure. Sodium pentachlorophenate at the rate of 24 pounds per acre, compared very well with 2 pounds per acre of 2,4-D (ester, amine or acid) in weed control and did not reduce the yield of corn. In general, 2 pounds per acre of 2,4-D (ester, amine or acid) and 24 pounds per acre of sodium pentachlorophenate used as pre-emergence sprays, sufficiently controlled broad-leaved and grassy weeds, to eliminate at least one and possibly two early cultivations. (Contribution of the Iowa Agricultural Experiment Station, Ames, Iowa.)

Project IV. Pre-emergence Treatments with Herbicides in Field and Truck Crops.

Sugar beets

Investigation leader: C. J. Willard

Summary

This year's results were like last year's in being different at different locations, and relatively inconclusive. There was one slightly favorable report on 2,4-D - an exception to all others this year and in previous years. Since 2,4-D gave severe stand reductions even in the favorably reported test, its value is still decidedly in question. Xanthogen disulphide (Sulfasan) was generally ineffective, E.H. No. 1 and E.H. No. 2 did not give much promise. IPC seemed worth another trial, as did PCP in oil and sodium PCP, despite some negative results. Sodium TCA was rather favorable in most tests, though giving severe stand reductions at the higher rates. Dinitros have some promise if some reduction in beet stands can be tolerated. Polybor caused reduced stands and continuing stunting of the beets through the season, and, though giving good weed control, its value is questionable.

No chemical gave weed control without materially decreasing the stand of beets. No chemical treatment for beets can as yet be recommended to farmers in humid regions.

Abstracts of Results of Cooperators

Sugar beets

Pre-emergence chemical treatments for weed control with sugar beets. Andersen, E. T. and Shadbolt, C. A. Treatments, chemicals, and concentrations, as recommended for trial in 1949 by the Regional conference on weed control in sugar beets held at the Agricultural Experiment Station, Fargo, N. D. in March, 1949, were tested insofar as it was possible to obtain the materials. The following pre-emergence treatments showed no measurable control of weeds, which were mostly pigweed (Amaranthus retroflexus), stinkweed (Thlaspi arvense), and purslane (Portulaca oleracea), or any significant effect on the beets: Experimental Herbicide No. 1 and No. 2 (Carbide and Carbon Chemical Corporation), Shell 130, XP-40A (Green Cross), Sodium PCP, PCP, Aero Cyanate, Diesel Oil No. 2, and IPC. Sodium TCA applied at rates of 10, 20, 30, and 40 pounds per acre showed considerable weed control throughout the summer. Weed counts for the treated plots ranged from 8 to 25 compared with 37 to 49 for the checks. Emergence and growth of sugar beets was also weakened and reduced, but a satisfactory stand of sugar beets was obtained, and growth appeared normal by the end of the season with all but the 40 lbs. treatment which reduced the size of the roots. Polybor applied at 320 pounds per acre resulted in a reduced stand of beets and a mild distortion and chlorosis of the beet foliage. At 640 pounds per acre good control of all weeds was obtained and the beets showed some chlorosis and reduced vigor. This reduction in vigor was continuous throughout the growing season. (Contri. of the Plant Science Division, The University of Manitoba, Winnipeg.)

Pre-emergence spraying with 2,4-D to control annual weeds in a variety of crops. Ford, P. H. Plantings were made, May 7th and 10th, of eleven different crops -- wheat, barley, oats, flax, field peas, field corn, sunflowers, sugar beets, meadow fescue, alfalfa, sweet clover -- on weed infested ground at two locations tributary to Winnipeg, one on clay soil where rainfall during the summer was considerably below normal, the other on light loam with rainfall average. Half of each trial plot was knapsack sprayed with an ester and an amine of 2,4-D respectively, at ½, 1, and 2 pounds acid per acre on the day of planting, the remaining half 5 days after planting. On the heavy soil the chief weed was stinkweed, with some wild buckwheat; on the light soil green millet, with some mustard and lamb's quarters. Pre-emergence application of 2,4-D, while failing to satisfactorily eradicate weeds, gave a measure of control, especially on the heavy soil location at the higher rates, with the 5-day treatment--this probably because the spray acted in part as in post-emergence. The only crops adversely affected were sugar beets and sunflowers, with limited damage to alfalfa. Any clover emerging was destroyed by weevil. Peas might seem to offer possibilities for pre-emergence treatment. (Contribution of the Extension Service, Manitoba Department of Agriculture, Winnipeg, Canada.)

Herbicides for pre-emergence use on sugar beets. Grigsby, B. H. In a series of 17 herbicides applied as pre-emergence treatments to sugar beets on the day of seeding and, on other plots, four days after seeding, no chemical was found to give satisfactory weed control without severe reduction of beet stand. TCA, dinitrophenol, PCP, IPC and diesel fuel show some promise, however, of being useful for weed control purposes, provided that the seeding rate is such that some loss of beets can be tolerated. TCA at 10 and 20 lb./A applied at seeding did not seriously affect beet emergence but higher rates and later application killed beets as well as weeds. Foxtail grass was suppressed at all rates but barnyard grass was not killed. Dinitrophenol in water reduced beet stands 25% at 1 lb./A. The same amount in diesel fuel caused a 60% reduction. IPC, emulsifiable form, at rates up to 20 lb./A did not reduce the stand of beets and gave 85% control of all weeds. In oil, however, these amounts caused stand reductions up to 60%. PCP at 4 and 8 lb./A caused stand reduction up to 50% and a similar degree of weed control. 16 lb. gave no better weed control and up to 90% stand reduction. All forms of 2,4-D used in these trials were extremely toxic to beets and were not effective in the control of weeds. (Contribution from Michigan Agricultural Experiment Station and BPISAE.)

Pre-emergence chemical weed control in sugar beets at Fargo-Moorhead, 1949. Swanson, C. R., E. A. Helgeson, R. Konzak and L. M. Stahler. Chemicals applied at planting and 4 days after. NaTCA applied at 10, 20, 30 and 40 lb./A; beet stand and vigor decreased with increasing concentration of the herbicide, but there appeared to be good weed control. Sinox 20 applied at 1, 1½ and 2 lb./A using water-diesel oil and water as carriers; beet stand was reduced slightly at lowest rate and more at higher rates, no weed control. E.H. No. 1 applied at 1, 2 and 4 lb./A; beet stand decreased with increasing concentration of herbicide, some control of weeds at all rates. E.H. No. 2 applied at 2, 4 and 8 lb./A; some reduction of beet emergence and some control of weeds at all rates. LFN 472 applied at 1 and 2 lb./A; beet stand severely reduced with some control of broadleaf and grass weeds. IPC applied at 5, 10, and 20 lb./A; Sulfasan applied at 4, 8 and 12 lb./A; KOCN applied at 10, 20 and 30 lb./A; and Chlorosol A applied at 20, 40 and 80 lb./A; no injury to sugar beets or weed control for these 4 herbicides. Diesel oil applied at 50 and 100 gal./A; beet stand reduced slightly at the higher rate, no weed control. Polybor applied at 320 and 640 lb./A; beet stand reduction noticeable at lowest rate and marked at highest, good weed control.

PCP in oil applied at 4, 8 and 12 lb./A and NaPCP applied at 16, 24 and 32 lb./A; a progressive decrease in beet seedling emergence and vigor occurred with increasing concentration of PCP; no grass control, but some control of broadleaf weeds at higher rates of application. XP-39A applied at 1, 3 and 5 qt./A; beet stand decreased at all rates, no broadleaf weed control, some grass control at higher rate. (Contr. Div. Cereal Crops and Dis., BPISAE, U. S. Dept. of Agric. and N. D. Agr. Exp. Sta.)

Pre-emergence weed control in sugar beets. Sexsmith, J. J. Duplicate plots of sugar beets were treated six days after seeding with Santobrite (Sodium pentachlorophenate) at 20 and 40 lb. per acre, Sulfasan (santhogen disulphide) at 5 and 10 lb. per acre, Cyanamid (calcium cyanamide - powdered) at 100 and 200 lb. per acre, and triethanolamine 2,4-D and butyl ester at 2,4-D each at 3/4 and 1½ lb. per acre. The Cyanamid was applied in the dry form, and all other treatments were in water at the approximate rate of 300 gal. per acre (Sulfasan emulsified with diesel fuel - 3 gal. per acre). Weed control of 80% or over was obtained from treatments with Santobrite 40 lb., and amine and ester 2,4-D at 1½ lb. Relatively severe reduction of unthinned beet stands resulted from Santobrite 40 lb. and all 2,4-D treatments. Varying degrees of malformation of early leaves were caused by above mentioned treatments as well as by Sulfasan at both rates used. Significantly higher yields resulted from Santobrite 40 lb., Sulfasan 5 lb., and all 2,4-D treatments. However, there was a significant negative correlation between number of beets per plot and beet yields, and it seems probable that stand reduction due to treatments were primarily responsible for the decrease in numbers of beets harvested and the increases in yield. No significant differences in sugar content were obtained. Treatments which gave over 80% weed control and reduced stands of unthinned beets would materially reduce thinning and weeding costs. (Contribution of Dominion Experimental Station, Lethbridge, Alberta.)

Beans, especially soybeans — Investigation leader, C. J. Willard

Summary

This year's results follow those of last year with 2,4-D, in that if there was no rain between application and the emergence of the beans, it was a valuable weed control chemical when applied pre-emergence. However, rain after application and before emergence of the beans caused losses in stand ranging up to total loss. In view of the uncertainties of Corn Belt weather, 2,4-D cannot be recommended on beans of any kind, even though the results obtained when the beans emerge without rain after application are outstandingly successful. Applying just before emergence is clearly less hazardous than applying on the date of planting.

When properly sown after the ground is well warmed up, soybeans will outgrow and smother most weeds. Herbicide tests with soybeans should be sown early, when the weeds tend to outgrow the soybeans.

Of the other chemicals tried, the dinitros gave the most uniformly good results under all weather conditions. The beans were severely damaged by them in wet weather, but there was no systematic effect and they outgrew the damage. (Lee, of Indiana, whose soybeans were too flooded to report on, noted that dinitros looked good.) Other chemicals, sufficiently favorable to experiment with further, are PCP in oil (aromatic oil had no advantage in the one reported comparison and applying in 40 gallons of water was no better than applying in oil directly),

sodium PCP, and, for grass weeds, IPC. (No formulation of IPC was easy to handle. Xanthogen disulfide was ineffective on weeds in all tests reported. E.H. No. 1 behaved like 2,4-D, and had no advantage over 2,4-D, except a lack of deformative effects if the spray drifted to other plants. TCA and E.H. No. 2 caused remarkable stunting, crinkling of leaves, and other systematic effects, and should not be used on beans.

Abstracts of Results of Cooperators

Soybeans

Pre-emergence weed control in soybeans. Slife, F. W. and Fuelleman, B. F. Soybean varieties were treated with 2 pounds of amine 2,4-D acid per acre as a pre-emergence treatment. These tests were conducted at Urbana and in northern Illinois at the DeKalb Experiment Field. The chemical was applied 3 days after planting. No rain fell at either location until the beans had emerged. Low rainfall in northern Illinois during the summer limited weed growth as well as the effectiveness of 2,4-D. The soybean varieties did not seem to be affected in any way by this treatment. At Urbana, the soil was higher in moisture and as the beans emerged some slight effect of 2,4-D was observed. These effects were twisting and bending of the leaves. There was no reduction in stand of beans due to treatment and they appeared normal after several weeks. On small plots at Urbana, soybeans were killed by pre-emergence treatment with 2,4-D when followed immediately by artificial watering to assimilate a heavy rain. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

The value of pre-emergence herbicides on soybeans. Willard, C. J. and Warren C. Shaw. Plantings were made June 7 (432 plots) June 22 (432 plots) and August 16 (180 plots). Six replications of each treatment in the first two, four of each in the last - randomized block designs. Variations in depth of planting were included in the first two (non-significant) and in date of application in all. The delayed applications were somewhat more favorable, both differences were slight under this year's conditions. Foxtail millet and rape were sown with the soybeans to simulate grass weeds and broadleaved weeds. Two replications of the first planting were left with natural weeds only, which proved very insufficient and unsatisfactory for rating. The June 7 planting had almost ideal weather - some rain, but not much: heavy rains made the June 22 planting difficult to treat: almost no rain for three weeks after the August 16 seeding. The chemicals used and brief comments on them, follow: PCP, phenol, in oil, 2 brands, 5 rates of each, favorable in normal weather, damaged beans in wet weather, but promising: sodium PCP, 4 rates, promising at times: Sulfasan (xanthogen disulphide) 5 rates up to 20 lb./A, no harm to soybeans or weeds, any date: three dinitros, 3 rates each, very promising (best average performance under all conditions) but causing severe damage to beans in wet weather: 2,4-D, two forms, three rates, very good if no rain before emergence of beans, fatal when there was much rain: E.H. No 1, like 2,4-D: TCA and E.H. No. 2, 3 rates, similar peculiar systematic effects, impossible on soybeans, little injury to crucifers at low rates: IPC, two forms, 3 and 4 rates, good control of grass at 8 lb./A or more, no harm to soys: IPC plus 2,4-D, 9 combinations, strictly additive effects of the two: KOCN, 3 rates, late application only, no effect. The first two seedings were grown to maturity. The beans themselves controlled the weeds, natural and planted, satisfactorily, so there was no possible profit in the use of any herbicide. The only herbicides which gave yields significantly below the 144 checks were 2,4-D and E.H. No. 1 in the June 22 seeding, TCA and E.H. No. 2 in both. No significant increases from any treatment.

Project IV. Pre-emergence Treatments With Herbicides in Field and Truck Crops

All Other Crops — Investigation leader: F. W. Slife

Summary

Reports were received on the use of chemicals for pre-emergence weed control in field peas, flax, alfalfa, spring oats, winter wheat, castors, sunflowers, canning peas, spring wheat, barley, sugar beets, meadow fescue, field corn, and sweet clover.

Weed control was quite variable. Little weed control was obtained when the chemicals were applied to dry or nearly dry soil with no rain for several weeks afterward. When the soil was moist at the time the chemicals were applied or if rain fell shortly after application then weed control was generally good. Chemicals applied to the soil 4 to 7 days after planting gave better weed control than applications immediately after planting.

Broad-leaved annual weeds were more easily killed by pre-emergence spraying of chemicals than annual grass weeds.

The relative resistance of the different crops tested to the various chemicals cannot be stated accurately since in no case were all crops included in one test.

The crop injury noted most frequently following chemical application was reduced stand. Growth of emerged plants was depressed in some cases, particularly when heavy rates of application were used.

Chemicals used in these various tests were different forms of 2,4-D, granular cyanamid, XP-40A, Dow Selective, Sinox general, K-1131, Sinox W, IPC, Expt. Herbicide No. 1, Expt. Herbicide No. 2, Sodium Pentachlorophenate, Sulfosan, TCA, and Pentachlorophenol in oil. Since only a few of these chemicals were used in different areas, it is impossible to indicate superiority or inferiority of these compounds. When weather conditions were favorable for pre-emergence treatment many of these chemicals did a good job of weed control. This indicates that more work should be done over a wider range of soil and climate.

Abstracts of Results of Cooperators

Pre-emergence Spraying With 2,4-D to Control Annual Weeds in a Variety of Crops. Ford, P. H. Plantings were made, May 7 and 10, of eleven different crops--wheat, barley, oats, flax, field peas, field corn, sunflowers, sugar beets, meadow fescue, alfalfa, sweet clover--on weed-infested ground at two locations tributary to Winnipeg, one on clay soil where rainfall during the summer was considerably below normal and the other on light loam with rainfall average. Half of each trial plot was knapsack-sprayed with an ester and an amine of 2,4-D, respectively, at 1/2, 0, and 2 pounds acid per acre on the day of planting, and the remaining half 5 days after planting. On the heavy soil the chief weed was stinkweed, with some wild buckwheat; on the light soil, green millet, with some mustard and lamb's quarters. Pre-emergence application of 2,4-D, while failing to satisfactorily eradicate weeds, gave a measure of control, especially on the heavy soil location at the higher rates with the 5-day treatment--this probably because the spray acted in part as in post-emergence. The only crops adversely affected were sugar beets and sunflowers, with limited damage to alfalfa. Any clover emerging was destroyed by weevil. Peas might seem to offer possibilities for pre-emergence treatment. (Contribution of the Extension Service, Manitoba Department of Agriculture, Winnipeg, Canada)

Pre-emergence Treatments on Dakota Flax. Friesen, H. A. Three formulations of 2,4-D were sprayed on Dakota flax at the rates of, viz., 1/2, 1, 2, 3 and 4 pounds of acid equivalent per acre. The sprayings were made at four dates: (1) immediately after planting, (2) 2 days after planting, (3) 4 days after planting, and (4) 6 days after planting. Weed growth occurred only on the untreated checks during the first 3 to 4 weeks after the flax was planted. After this period the stand of weeds, on the plots treated with the sodium salt at 1/2, 1 and 2 pounds, the amine at 1/2 and 1 pound and the ester at 1/2 and 1 pound per acre, was approximately 60 percent of the stand on the untreated plots. The chief weed on both the treated and untreated plots was Russian thistle, Salsola Kali with a scattering of stinkweed Thlaspi arvense, lambs' quarters Chenopodium album and wild buckwheat Polygonum convolvulus. The other treated plots, except for a few scattered plants of Russian thistle and wild buckwheat, remained weed-free until early August. The emergence of flax on both the treated and untreated plots was not uniform; however, the stands on the treated plots appeared to be poorer than the checks. Unfortunately an accurate study of the effect of the treatments on the flax plants could not be made because of a severe frost six days after emergence, which killed 95 percent of the crop. (Contribution of the Dominion Experimental Station, Scott, Sask.)

Treatment of Soil With 2,4-D Before Planting Flax. Heggeness, H. G. and Herbert G. Johnson. Four different soils were brought in from the field in October, 1949. Their characteristics were as follows:

Soil type	pH	Percent org. matter	Percent colloid	No. microorg. per gram fungi	Bact.	Soil class
Peat	6.2	17.5	8.8	10,400	360,000	Silt loam
Mineral	7.0	5.3	12.0	5,000	460,000	Silt loam
Mineral	7.5	4.2	14.0	17,300	475,000	Silt clay loam
Clay	8.4	1.2	17.0	6,500	275,000	Sandy clay

The effect of the pretreatment of these soils with an amine salt of 2,4-D was studied. Three variables of four items each were used, i.e., 4 soils, 4 concentrations of herbicide, and 4 times of application of herbicide. Crystal flax was used as a test plant. The plants in soil with relatively high organic matter, low pH, and low colloid content gave the best emergence and growth. In general, emergence and growth were less at higher 2,4-D concentrations. This effect was considerably less in the case of the high organic soil. The greater the time elapse between application of 2,4-D and planting, the less injurious the effect of the 2,4-D. Applications did not affect the type or numbers of soil microorganisms. The 2,4-D appeared to diffuse uniformly through the soil. (Contribution of the Minnesota Agricultural Experiment Station)

Effect of Various Chemicals at Several Rates of Application Applied as Pre-emergence Sprays on Flax at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized 4 foot by 16 foot plots of flax were treated in triplicate 4 days after seeding and 7 days after seeding with 1 or 1 1/2 pounds acid per acre of triethanol amine salt or micronized acid of 2,4-D; 2 or 3 pounds acid per acre of experimental herbicide No. 1; 2 or 4 pounds per acre of Sulfosan; 20 or 40 pounds acid per acre of TCA; 8 or 16 pounds in water or 8 pounds in oil of PCP. Wild oats (Avena fatua) and other common annual weeds were sown with the flax on one-half of each plot. Weed counts were made on June 28 Extreme drought conditions reduced flax yields. No material difference was found in weed counts between untreated and treated plots. An analysis of variance indicates that yields were changed by rates of some chemicals, and an L.S.D. at the 5 percent level indicates that the TCA at 20 or 40 pounds per acre and PCP at 8 pounds in water lowered the yields significantly when applied 4 days after seeding. TCA at 40 pounds per acre significantly lowered the yield when applied 7 days after seeding. (Contribution of the Agronomy Department, South Dakota Agricultural Experiment Station, and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.)

Use of Pre-emergence Treatments in the Control of Weeds in Canning Peas. Leef, J. S. Pre-emergence treatments of granular cyanamid 60,200 and 600 pounds per acre and isopropyl ester of 2,4-D, 3/4 and 1 1/2 pounds per acre were used. Treatments were applied seven days after seeding Thomas Laxton peas. Weed counts made one week after peas emerged showed nearly 100 percent reduction in weeds where the high rates of cyanamid or 2,4-D were used. Other rates were intermediate. In one replication only 1 1/2 pounds 2,4-D acid damaged the seedling peas. In this case the damage was almost 100 percent. By harvest time no differences could be noticed in weed density, as late-germinating weeds had filled in the treated plots. All treatments but the lowest rate of cyanamid produced useful increases in yield of shelled peas. The weeds found were wild radish (Raphanus raphanistrum) spurry (Spergula arvensis) and to a lesser extent lamb's quarters (Chenopodium album). (Contribution of the Dominion Experimental Station, Kentville, N.S.)

Use of Herbicides for Annual Weed Control in Alfalfa. Shafer, Neal E. Annual weeds such as kochia, pigweed, lambs' quarters, downy brome, and little barley are often a problem in the first cutting of alfalfa in Nebraska. Later cuttings may be troubled with quantities of foxtail, barnyard grass, and crabgrass. Nine different herbicides were applied to duplicate 8' x 16' plots. Treatment was made April 19 when the alfalfa was from emerging to 3-5 inches in height, but prior to emergence of most weed species. Many weed species were delayed in germinating by the presence of a cover of weed residue left from the previous year. This residue was burned April 9.

Sinox general and K-1131 at 1 pound and 2 pounds and Sinox W and Dow selective at 4 pounds and 8 pounds gave 60 percent to 70 percent control of all weeds for approximately four weeks with no harmful effect on the alfalfa. One pound of 2,4-D sodium salt gave 80 to 90 percent reduction in broadleaf species and 50 to 60 percent reduction in grassy weeds with no visible effect on the alfalfa. Weed control through herbicidal action and competition of the alfalfa lasted until the alfalfa was cut. Carbon and Carbide Company's Herbicide No. 1 at 1 pound and 4 pounds per acre also gave good weed control (60 to 90 percent) without injury to the alfalfa. Herbicide No. 2 caused a browning of weeds and alfalfa at rates of 1 pound and 4 pounds per acre. I. P. C. at 2 pounds and 8 pounds per acre effectively controlled little barley, green and yellow foxtail, and barnyard grass with injury to the alfalfa. Sodium pentachlorophenate at 8 pounds and 10 pounds per acre caused no damage to weeds or alfalfa. (Contribution of the Department of Agronomy, Nebraska Agricultural Experiment Station)

Effect of 2,4-D, Pre-emergence, on Oats. Shaw, W. C. and C. J. Willard. The tri-ethanol amine salt and the butyl ester of 2,4-D were applied to Clinton 59 oats at 0, 1/4, 1/2, 1, 2, and 4 pounds per acre 4 days after planting. There was a slight reduction in yield, not statistically significant, at 2 and 4 pounds per acre, but the yields following all rates were higher than following any post-emergence treatment at those rates. (Contribution of the Ohio Experiment Station)

Effect of 2,4-D, Pre-emergence, on Winter Wheat. Shaw, W. C. and C. J. Willard. 2,4-D applied October 9 to Thorne wheat planted October 4 resulted in significant reduction of stand and yield at 2 and 4 pounds per acre, and some reduction, not statistically significant at 1/4, 1/2, and 1 pound. There was no difference in the results from the butyl ester and the tri-ethanol amine. The protein content of the wheat from the 1-, 2-, and 4-pound treatments was increased, the increase being proportional to the decrease in yield. The protein per acre was not increased. Satisfactory meadow seedings from March sowing were obtained on these plots. (Contribution of the Ohio Experiment Station)

2,4-D as a Pre-emergence Treatment on Winter Wheat. Slife, F. W. and R. F. Fuelleman. Replicated square rod plots of winter wheat (variety Royal) were given a pre-emergence treatment 3 days after sowing. Rates used per acre were 2, 4, and 8 pounds of 2,4-D acid in the amine form. The soil was a brown silt loam and was high in moisture at the time of treatment. Rainfall the month following treatment was well above normal. At the 2-pound rate, approximately 50 percent of the wheat emerged and lived through the winter. On plots treated with 4 pounds, 25 percent of the wheat emerged but none survived the winter. No wheat emerged on the plots treated with 8 pounds. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois)

Pre-emergence Treatment of 2,4-D on Castors and Sunflowers. Slife, F. W. and R. O. Weibel. Castors and sunflowers were treated with 2 pounds of 2,4-D acid in the amine form 2 days after planting. The soil was a brown silt loam. No rain fell for 10 days. The castors and sunflowers emerged 5 days after planting with a marked reduction in the stand of castors. Sunflower stand was not reduced by treatment. Slight effects of 2,4-D, such as twisting of the stems and distortion of the leaves, could be observed on both the castors and sunflowers. These effects disappeared within several weeks, and plants matured normally. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois)

Pre-emergence weed control in canning peas. Sexsmith, J. J. Duplicate plots of Climax canning peas were treated six days after seeding with Santobrite (sodium pentachlorophenate) at 20 and 40 lb. per acre, Sulfasan (santhogen disulphide) at 5 and 10 lb. per acre, Cyanamid (calcium cyanamide - powdered) at 100 and 200 lb. per acre, and triethanolamine 2,4-D and butyl ester 2,4-D each at 3/4 and 1½ lb. per acre. The Cyanamid was applied in the dry form, and all other treatments were in water at the approximate rate of 235 gal. per acre (Sulfasan emulsified with diesel fuel - 3 gal. per acre). Reasonably good control of redroot pigweed and lambs' quarters was obtained with Santobrite at 40 lb., amine 2,4-D at 1½ lb., and ester 2,4-D at 3/4 and 1½ lb. as judged by observation one month after treatment. The stands of peas one month after treatment were seen to be slightly reduced by Santobrite 40 lb. and all 2,4-D treatments, with some stunting of plants observed for both amine and ester 2,4-D at 1½ lb. No significant yield differences of shelled peas were obtained. Significantly lower weights of green weeds were obtained from all treatments with the exception of Cyanamid at 100 lb., with least weight of weeds from the Santobrite 40 lb. treatment, amine 2,4-D at 3/4 and 1½ lb. (Contribution of Dominion Experimental Station, Lethbridge, Alberta.)

Use of herbicides for annual weed control in alfalfa. Shafer, Neal E. Annual weeds such as kochia, pigweed, lambsquarters, downy brome, and little barley are often a problem in the first cutting of alfalfa in Nebraska. Later cuttings may be troubled with quantities of foxtail, barnyard grass, and crabgrass. Nine different herbicides were applied to duplicate 8' x 16' plots Treatment was made April 19 when the alfalfa was from emerging to 3-5 inches in height, but prior to emergence of most weed species. Many weed species were delayed in germinating by the presence of a cover of weed residue left from the previous year. This residue was burned April 9. Sinox general and K-1131 at 1 pound and 2 pounds and Sinox W and Dow selective at 4 pounds and 8 pounds gave 60 percent to 70 percent control of all weeds for approximately four weeks with no harmful effect on the alfalfa. One pound of 2,4-D sodium salt gave 80 to 90 percent reduction in broadleaf species and 50 to 60 percent reduction in grassy weeds with no visible effect on the alfalfa. Weed control through herbicidal action and competition of the alfalfa lasted until the alfalfa was cut. Carbon and Carbide Company's Herbicide No. 1 at 1 pound and 4 pounds per acre also gave good weed control (60 to 90 percent) without injury to the alfalfa. Herbicide No. 2 caused a browning of weeds and alfalfa at rates of 1 pound and 4 pounds per acre. IPC at 2 pounds and 8 pounds per acre effectively controlled little barley, green and yellow foxtail, and barnyard grass with injury to the alfalfa. Sodium pentachlorophenate at 8 pounds and 10 pounds per acre caused no damage to weeds or alfalfa. (Contribution of the Department of Agronomy, Nebraska Agricultural Experiment Station.)

Effect of Pre-emergence Treatments With Herbicides on Field Peas. Taylor, D. K. Pre-emergence applications of the ester of 2,4-D at 1, 2 and 3 pounds per acre, and calcium cyanamid at 75, 150 and 300 pounds per acre, were applied to plots of Alaska peas four days after planting and just previous to emergence. Other treatments included XP-40A at 1 1/2, 3, 6 and 12 quarts per acre just previous to emergence and Dow Selective at 3 quarts per acre when the peas were 4 inches in height. Of the pre-emergence treatments, calcium cyanamid at 300 pounds per acre four days after seeding gave the best control of broad-leafed weed species and a partial control of barnyard grass (Echinochloa crusgalli) without apparent injury to the peas. Lighter rates gave less control, and later applications resulted in more injury. XP-40A gave excellent weed control but at 1 1/2 quarts resulted in slight distortion and, at higher rates, severe injury and reduction of stand. Treatments with 2,4-D four days after planting resulted in basal distortion of the pea vines and a temporary loss in vigor. Similar treatments applied just before emergence resulted in reduction of stand and significant reductions in yield. Calcium cyanamid at the higher rates significantly increased yields over the check, while all other treatments were not significantly different from the check in yield. A heavy stand of barnyard grass provided severe competition and contributed to the lack of further significant yield differences. (Contribution of the Dominion Experimental Farm, Agassiz, B.C.)

Project V. The Use of Herbicides in Horticultural, Truck Crops and Potatoes

Vegetable Crops — Investigation Leader: E. K. Alban

Summary

Abstracts received covering herbicidal studies with vegetables during the 1949 season included six reports on onions, two on potatoes and one each on sweet corn, snap beans, peas, tomatoes, carrots, beets, radishes, spinach, and lettuce. The chemicals included in these studies were 2,4-D, Aerocyanate, Aero-cyanamid, aromatic oils, pentachlorophonol, sodium pentachlorophenate, sodium isopropyl xanthate, sodium tri-chloroacetate, isopropyl N phenyl carbamate, methoxone, Exp. Herb. #1, NIX, and the ammonium salt of dinitro O see butylphonol.

The results in general parallell those of the past two years. Additional information is included on the use of TCA, PCP sodium salt, and IPC pre-emergence sprays with some of the above crops and in most reports these materials have not been very satisfactory.

Pre-emergence applications of methoxone, 2,4-D, NIX, Aromatic oils, and Exp. Herb. #1 have produced varying results. Based on previous studies, and concurrent results available, the results with these materials by crops are in general agreement. Also cyanate in post-emergence weed control in onions has produced variable results over the North Central States during the past season. Soil and environmental differences in relation to onion and weed growth apparently account for these results.

Effect of post-emergence and pre-emergence applications of 2,4-D on potatoes. Andersen, E. T., and Shadbolt, C.A. Post-emergence applications of 2,4-D were made on Canus potatoes in duplicate at 0.5 and 1 pound per acre rates using the two formulations, butyl ester and sodium salt. Applications were made at two dates to separate plots; one when the plants were 5 to 6 inches high, and one when the plants were in the late pre-bloom stage. Plants receiving the early treatments exhibited typical 2,4-D symptoms and made little further growth. Plants receiving the later treatments showed only slight distortion but produced few blossoms when compared with the check plants. Plant development otherwise appeared quite normal, and yields compared favorably with those of the check plants. Weeds, largely red root pigweed (Amaranthus retroflexus) and stinkweed (Thlaspi arvense) were satisfactorily controlled in all cases, but the ester was more effective than the sodium salt. Pre-emergence treatments of 2,4-D were made on Katahdin potatoes using the two formulations, butyl ester and sodium salt at 1 and 2-pound rates per acre. These were applied just before the emergence of the potatoes. Slight injury to the plants in the form of foliage distortion appeared in all treatments, with the ester producing more marked effects than the sodium salt. This distortion was soon outgrown and the potatoes matured normally. The yields from the treated plots were on a par with those of the check plots. Weed control with all treatments was so effective that no further weeding was required in any of the plots. (Contrib. of Division of Plant Science, The University of Manitoba, Winnipeg)

The effect of post-emergence treatments of 2,4-D on non-irrigated and irrigated sweet corn. Andersen, E.T. and Shadbolt, C.A. Marcross and Sugar Prince sweet corn plots were sprayed on July 4 with ½ and 1 pound treatments of the butyl ester of 2,4-D. Corn plants at time of spraying averaged about 18" in height and weeds about one foot. Nearly all weeds were red root pigweed (Amaranthus retroflexus). One half of the plots were given approximately an inch of irrigation water with a sprinkler system, 24 hours after treatment and again 2 weeks after treatment. The other half was not irrigated. Weed control with all treatments, both irrigated and non-irrigated, was very good and no cultivation was deemed necessary. No differences in weed control or yields were found when comparing the irrigated plots to the non-irrigated. Considerable lodging was in evidence shortly after treatment and this was more marked in the irrigated plots. Maturity was delayed 3-5 days as a result of the 2,4-D treatments. A similar delayed maturity effect was brought about by the irrigation so that the treated irrigated plots ranged from 5-7 days later in maturity than the non-irrigated checks. (Contrib. by the Plant Science Division, The University of Manitoba, Winnipeg)

The use of Aero Cyanate (Potassium Cyanate) as a herbicide in onions. Andersen, E. T. and Shadbolt, C. A. Aero Cyanate was applied to Ebenezer onions grown for Dutch set production at 6, 12, 24, and 36-pound rates per acre. Applications were made (1) when the onions were 2-3 inches high, (2) 5-6 inches high, and (3) at both stages. At the time of the early application the weeds were all annuals, and mostly red root pigweed (Amaranthus retroflexus), and wild buckwheat (Polygonum convolvulus) had 4 leaves or less. At the time of the later application most had 8 leaves or more. The 6 and 12-pound applications in all cases showed only slight burning of the weed foliage, with no satisfactory weed control. At the higher rates, the pigweed was found to be quite susceptible, while wild buckwheat was considerably more resistant. No injury to the onions could be detected as a result of any of the treatments. Those plots receiving two applications were the only ones in which satisfactory weed control was obtained, and this was only with the 24 and 36-pound treatments. These same plots also produced a higher yield of Dutch sets than either of those receiving single applications. Considerably better control of weeds was

obtained with the early single treatments than with the later single treatments. The results indicated clearly that small weeds were much more easily destroyed by the chemical than larger and older ones. (Contrib. of Division of Plant Science, The University of Manitoba, Winnipeg)

Pre-emergence treatments in the control of weeds in onions. Bakke, A.L. and D. W. Staniforth. In 1948, it was found that pre-emergence applications of 2 pounds of the amine and two pounds of the ester formulation of 2,4-D gave good control of weeds in onions for about three weeks after the onion plants were up. The number of treatments in 1949 were increased and emphasis was placed on the tolerance of the onion plants. Weed-No-More 2 lbs., Herbicide 1-10 pounds, P.C.P. in oil 20 lbs., materially reduced the stands. Weed-No-More, 1 lb., L.F.N., 1 and 2 lbs., amine 1 and 2 lbs., Aero Cyanate, Stanisol, Herbicide 1-5 lbs. did not produce yields significantly different from the control. In all cases it was necessary to do some hand weeding. (Contrib. Iowa Agricultural Experiment Station, Ames, Iowa)

The effect of pre-emergence herbidies on weed control, stands and yields of snap beans. Cockrum, E. E. and Warden, R. L. Tendergreen snap beans were planted in a four replication randomized test on June 14 in a dry soil (Huffine silt loam) and sprinkler irrigated with one acre inch. Also rains totalling 1.67 inches fell before the herbicide could be applied on June 23. An additional .84 inches precipitation fell after application of the herbicides and before bean emergence was complete. The herbicide used, rate per acre and percent weeds (red root pigweed, lambsquarter and wild mustard) remaining are listed for each chemical as follows: Exp. Herb. #1, 2.5 lbs., 33%; NIX, 15 lbs. Na salt basis, 3%; and Na 2,4-D, 1 lb. acid equiv., 23%. As soon as weed emergence readings were taken, weeds in all plots were controlled mechanically so that differential herbicidal effects could be measured. There were no significant stand or yield differences in this test. The NIX treatments appeared to stimulate early growth as was evidenced by greater leaf size and plant height. These differences were still visible at picking time. Yields from the NIX treatments averaged about 25% above the check but because of the large experimental error, differences were not significant. Sodium pentachlorophenate at the high rate appeared to produce early injury (leaf chlorosis and necrosis) but plants recovered and yielded essentially the same as the check. The low rate of NaPCP did not produce a marked amount of early injury. The 2,4-D and the Exp. Herb. #1 did not depress yields but did produce early formative effects. The NaPCP rates were outstanding in control of weeds. Cooked samples from each of the treatments showed no appreciable differences in flavor and quality. (Contrib. of Montana Agricultural Experiment Station)

Response of peas to pre-emergence treatments with Exp. Herb. #1 and NIX. Cockrum, E.E. and Warden, R.L. Thomas Laxton peas were planted in rows in a four replication randomized test on June 14, 1949 in a dry soil (Huffine silt loam). A one inch irrigation by sprinkler was applied the day after planting. Rain to the extent of 1.67 inches fell before the herbicides could be applied on June 23. An additional .84 inch fell before emergence of the peas was complete on June 26. Exp. Herb. #1 was applied at the rate of 2.5 pounds per acre and NIX at 15 and 30 pounds per acre. Weeds present were red root pigweed, lambsquarter and wild mustard. Weeds emerging on the Exp. Herb. #1 plots were 24 percent of the check, NIX at 15 pounds allowed 21 percent of the weeds to develop while NIX at 30 pounds suppressed all but 9 percent. As soon as weed emergence readings were taken, weeds in all plots were controlled mechanically so that differential herbicidal effects could be measured. The NIX treatments yielded significantly more than the Exp. Herb. #1 treatment

and yielded 7 percent more than the check although the difference was not significant. There were no significant differences in pea stands. The NIX plots appeared to have a more vigorous vegetative growth and a larger number of pods than did the check or Exp. Herb. #1 plots. Cooked samples from each of the treatments showed no appreciable difference in flavor or quality. (Contrib. of the Montana Agricultural Experiment Station)

Post emergence weed control in onions with Aero Cyanate, NIX and Exp. Herb.#1. Cockrum, E.E. and Warden, R.L. Mountain Danvers onions were transplanted on May 24 and sprayed with herbicides on June 23. Because a series of rains (1.67 in.) delayed treatments about a week beyond the ideal stage, the weeds (red root pigweed, lambsquarter and mustard) were from one to four inches in height at the time of application. The onions were about 10 inches in height. The herbicide used, rate per acre in 50 gals. water, and percent of weeds remaining are listed for each chemical as follows: Aero Cyanate, 10 lbs., 78%; Aero Cyanate, 20 lbs., 23%; NIX, 15 lbs., 33%; NIX, 30 lbs., 25%; Exp. Herb. #1, 2.5 lbs., 100%; Exp. Herb. #1, 4.0 lbs., 90%. Rains totaling 1.33 in. fell within four days following application, of which .08 in. fell at about 8:30 p.m. following application in afternoon. The onions did not appear to be injured by the low rate of Aero Cyanate but the 20 lb. rate produced a slight burning. NIX at the 15 lb. rate caused slight burning and the 30 lb. rate produced somewhat more burning immediately after application. Both rates of Exp. Herb. #1 caused no visible injury. As soon as data on chemical weed control were taken, weeds in all plots were controlled mechanically so that differential herbicidal effects could be measured. There were no significant differences in yield due to using any of the herbicides. (Contribution of Montana Agricultural Experiment Station)

The effects of Exp. Herb. #1 and NIX on pre-emergence weed control, stands and yields of radishes, spinach and lettuce. Cockrum, E. E. and Warden, R. L. Cavalier radish, Northland spinach and Great Lakes lettuce were seeded in a four replication randomized test on June 15. The plan called for transplanted head lettuce, but since plants were not available, it was decided to direct seed. A one-inch irrigation was applied by sprinkler the day of planting. Rains totaling 1.67 inches delayed application of the herbicides until June 23. By this time about 25% of the radishes and 15% of the lettuce had emerged. The spinach started to emerge the following day. An additional .84 inch of rain fell before emergence was complete on June 26. Exp. Herb. #1 was applied at rates of 2.5 and 4 pounds per acre and NIX at 15 and 30 pounds per acre. Weeds emerging (red root pigweed, lambsquarter and mustard) on the 2.5 lb. rate of Exp. Herb. #1 plots were 25% of the check and the 4.0 lb. rate 13%. NIX at 15 lbs. allowed 5% of the weeds to develop and the 30 lb. rate suppressed all but 3%. As soon as weed emergence readings were taken, weeds in all plots were controlled mechanically so that differential herbicidal effects could be measured. Both rates of Exp. Herb. #1 severely reduced radish stands, yields and quality. NIX at the high rate significantly reduced stands and yields. While the 15 lb. rate of NIX killed most of the radishes emerging before treatment, those emerging later were uninjured and had no abnormalities. Spinach stands and yields were significantly reduced by both rates of Exp. Herb. #1, as well as the high rate of NIX. However, the 15 lb. rate of NIX gave the same stand as the check and the yield was slightly higher. Stands and yields from the direct seeded lettuce were markedly reduced by all treatments. (Contribution of the Montana Agricultural Experiment Station.)

The effects of Exp. Herb. #1 and NIX on pre-emergence weed control, stands and yields of carrots and garden beets. Cockrum, E.E. and Warden, R. L. Tendersweet carrots and Perfected Detroit beets were planted in a three replication randomized test on June 15 in a dry soil (Huffine silt loam). A one inch irrigation was applied by sprinkler after planting. Rain to the extent of 1.67 inches fell before the herbicides could be applied on June 23. An additional 1.33 inches precipitation fell before emergence of either crop was complete. Beet emergence began on June 25 and emergence was complete on June 27. Carrot emergence was complete on July 1. Chemicals used in this test were Exp. Herb. #1 at 2.5 and 4.0 pounds per acre and NIX at 15 and 30 pounds per acre. Weed populations (red root pigweed, lambsquarter and wild mustard) were reduced to 28 and 5 percent respectively by the two rates of Exp. Herb. #1, and to 12 and 1 percent respectively by the two rates of NIX. As soon as emergence readings were taken, weeds in all plots were controlled mechanically so that differential herbicidal effects could be measured. Beet stands and yields were reduced significantly by both rates of Exp. Herb. #1 while NIX at the 30-pound rate reduced stands but not yields. The 15-pound rate of NIX was not significantly different from the check in either stand or yield. Carrot emergence was completely inhibited by the 4-pound rate of Exp. Herb. #1, and reduced to 14 percent of the check by the 2.5-pound rate, which resulted in a marked reduction in yield. The 30-pound rate of NIX reduced the stand and yield of carrots, but differences were not significant, whereas the 15-pound rate of NIX improved the stand and yield but the differences were not large enough to be significant. The Exp. Herb. #1 treatments produced forked carrots and beets, while NIX treatments produced normal carrots and beets. (Contrib. of the Montana Agricultural Experiment Station)

Effects of pre-emergence treatments on onion stands and yields. B.H. Grigsby. Replicated plots of five varieties of onions were treated with twelve different herbicidal formulations. All treatments were applied six days after seeding on muck soil. Due to a late frost no weed control data were obtained but stand and yield data were secured for each variety and treatment.

Amine, ester and sodium salt forms of 2,4-D applied at 2 lbs/A reduced stands in all plots treated but the effects were greatest on Sweet Spanish onions and least on yellow globe onions. For all varieties the average reductions were: Amine 19%, ester 65% and sodium salt 58%, yield reductions were: 11%, 54%, and 58% respectively.

PCP, sodium salt, at 16 lbs/A reduced stands an average of 96% and yields 79%. PCP in oil reduced stands 40% but yields were reduced only 8%.

TCA, at 4 lbs/A, reduced the stand only 10% but a yield reduction of 23% was found. IPC, in emulsifiable oil, at 4 lbs/A reduced stands by 15% but yields were equal to untreated plots.

Sodium isopropyl xanthate, at 8 lbs/A, caused a stand reduction of 16% but did not depress yield. Two petroleum fractions with 12-20% aromatics reduced stands 18-20% but yields in these plots were greater than in the checks.

These data indicate that a stand reduction of less than 15% may not reduce the yield of onions where the normal seeding rate produces 10-12 plants per foot of row. Greater stand reduction, however, may be reflected in reduced yields.

This series of plots also indicates that the effects of TCA may last throughout the growing season and result in a lower yield of crop in muck soil. (Contrib. from Michigan Agricultural Experiment Station)

Effects of TCA and PCP, sodium salt, on onions. B. H. Grigsby. TCA, applied at the rate of 4 lbs/A was used as a pre-emergence treatment and as a post-emergence treatment. In the latter case the onions had developed two true leaves at the time of spraying. Slight reduction in number of onion plants per foot of row was found when TCA was applied as either a soil treatment or as a selective spray. No noticeable effects were observed on the onion bulbs at harvest time but yields were less than those in untreated plots.

PCP, sodium salt, 2% solution at 100 gal/A produced severe stand reductions and also reduced yields. (Contrib. from Michigan Agricultural Experiment Station)

A study on the use of 2,4-D and Methoxone for the control of weeds in Irish potatoes. Nylund, R.E. Irish Cobbler potatoes planted in a well-drained muck soil on May 3 were sprayed on May 27 (plants were about 75% emerged) and on June 20 (plants in early bud stage) with various rates of 2,4-D (Na salt) and Methoxone. When either 1 lb. or 2 lbs. of 2,4-D acid per acre was applied to emerging potato plants, no reductions in yield were obtained. Similarly, when $\frac{1}{2}$ lb. or 1 lb. of 2,4-D acid was applied to previously untreated plants at the bud stage (June 20), no reductions in yield were obtained. However, when the early and late applications of 2,4-D were applied to the same plants (1 lb. followed by $\frac{1}{2}$ lb., 1 lb. followed by 1 lb., 2 lbs. followed by $\frac{1}{2}$ lb., and 2 lbs. followed by 1 lb.) significant reductions in yield occurred, and yield reductions ranging from 15% in the 1 lb. + $\frac{1}{2}$ lb. treatment to 30% in the 2 lb. + 1 lb. treatment. None of the Methoxone treatments (1 lb. acid applied late, 1 lb. acid early plus 1 lb. acid late, and 2 lbs. acid early plus 1 lb. acid late) caused significant reductions in yield. Weed counts made after the May 27 application showed that 1 and 2 lbs. of 2,4-D and 1 and 2 lbs of Methoxone were all equally effective in controlling weeds. None of the weedicide treatments caused significant reduction in dry matter content of harvested tubers. (Paper No. 676 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota)

A study on the control of weeds in onions by pre-emergence application of herbicides. Nylund, R.E. On April 28, 1949, Southport Yellow Globe onions were seeded in a well-drained muck which had been prepared for seeding on April 24. Eight days after seeding, at which time numerous small annual weeds were present but onions had not yet emerged, the following herbicide treatments were applied to quadruplicated three-row plots 25 feet in length: Aero Cyanamid (special) at 75 lbs. and 150 lbs. per acre, Stoddard Solvent at 40 and 80 gal. per acre, Amsco "D" and Esso #45 at 40 gal. per acre, Bronoco Hi-Sol #45 at 80 gal. per acre, and 3% and 4% Aero Cyanate at 80 gal. per acre. The soil was moist at time of application and the air temperature 60° F. Onions emerged three days after herbicide applications. All of the treatments, with the exception of Aero Cyanamid at 75 lbs. per acre and Stoddard Solvent at 40 gal. per acre, gave satisfactory weed control (75 to 90% kill). On the basis of a general rating made at the time of weed counts and based on both weed control and injury to onions, the following five treatments appear to be most promising: ESSO #45 at 40 gal. per acre, Bronoco Hi-Sol #45 at 80 gal. per acre, 3% and 4% Aero Cyanate at 80 gal. per acre, and Stoddard Solvent at 80 gal. per acre. Unfortunately, due to serious damage by cutworms which resulted in reduced stand, no yield records were obtained. (Paper No. 677 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota)

Pre-emergence weed control in direct-seeded tomatoes. Warren, G.F. and C. C. Singletary. A replicated experiment was conducted on Rutgers tomatoes seeded directly in the field on May 5 in a light-colored silt loam soil. On May 21, PCP

(9.4% in oil) at 2½ and 5 gallons per acre, PCP (sodium salt) at 8 pounds, TCA (sodium salt) at 4.4, 8.8, and 17.6 pounds of acid equivalent, 2,4-D (amine salt) at ½, 1 and 2 pounds of acid equivalent, DNOSBP (ammonium salt) at 2 pounds were all applied in 50 gallons of water per acre and Stoddard solvent was applied undiluted at 50 gallons per acre. A large number of annual broadleaved and grass weeds were present when spraying was done but no tomatoes emerged until two days afterward. Rainfall totaled 1.75 inches during the 24 hours after treatments were applied. All treatments reduced the stand of both grass and broadleaved weeds by 75 percent or more. The stand of tomatoes was significantly reduced by all treatments except PCP (9.4% in oil) at 2½ and 5 gallons per acre. The latter treatments also did not reduce the yield. A similar experiment was conducted in another field. Only a few light showers occurred for ten days after the treatments were applied. In this experiment PCP (9.4% in oil) at both rates, TCA at 4.4 pounds and Stoddard solvent at 50 gallons per acre all gave good results with no reduction in yield of tomatoes. (Contrib. of the Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana)

Project V. Investigation of Weed Control Methods in Small Fruits.

Summary

Investigation Leader: Glenn Viehmeyer

The number of abstracts submitted if taken alone, are inconclusive and cannot be considered sufficient to serve as a basis for recommendations for the use of herbicides in small fruit crops; however, if they are used to supplement data from other sources and that reported at past conferences, certain recommendations seem possible.

Strawberries

Three cooperators reported on the use of 2,4-D for weed control in strawberries. These reports, when considered with those of past conferences and those from other sources, indicate that the herbicide will effectively control certain broad-leaved weeds in strawberries with no permanent injury to the plants and that such use can berecommended by the conference.

A single cooperator reports spraying strawberries while in full fruit with no damage to the crop but others have reported distorted fruit from such application and it seems inadvisable to recommend treatment to fruiting plants without additional investigation.

It has been reported that IPC at 5, 10, 15 pounds per acre did not injure strawberry plants but that plants were damaged by applications of 25 pounds of this herbicide per acre. At the 15 and 25 pound levels chickweed was completely controlled. The 5 and 10 pound rates gave partial control. More investigation of this herbicide is indicated.

Raspberries:

A single abstract reports on TCA for weed control in raspberries. Dosages adequate for weed control resulted in serious injury to the crop plant. This agrees with past results and it appears improbable that TCA can be used to control weeds in fruit crops.

Orchards

A report on 2,4-D and 2,4,5-T for poison ivy control in orchards indicated that the latter is more effective for controlling this weed pest and that June and July treatments were more effective than those applied at later dates.

These same chemicals used on horse nettle gave the greater control if applied during the early fruiting stage with 2,4-5-T being more effective than 2,4-D in controlling both weed species.

It is unfortunate that so few cooperators conducted investigations on weed control in fruits and considerably more investigation will be needed to determine the possibility of chemical weed control in these crops. When all sources of information are studied it appears that 2,4-D could play an important part in weed control in raspberries and strawberries but additional investigation is needed to fully determine the value of the herbicide for weed control in fruit.

Trichloroacetic acid, sodium salt, aplied for the control of quack grass (Agropyron repens) growing in black raspberries. Davidson, J. H. Sprays containing TCA sodium salt were applied at the rates of 20, 40, and 80 pounds TCA equivalent in 300 gallons of water per acre. Applications were made October 21, 1949. The soil was a light sand with a heavy quack grass sod around the raspberry plants. Rainfall during the fall, winter and early spring was below normal. In the spring of 1949 emerging leaves on the old fruiting canes were small, deformed and chlorotic. These canes died later in the spring. New shoots from the crown appeared normal until mid-summer when they showed definite chlorosis which became progressively worse as the season advanced. This injury was apparent with 20 lb. and severe with 80 lb. Quack grass control was poor with the 20 lb. and good with 80 lb. (Contribution of the Dow Chemical Co., South Haven, Mich.)

Sprays of 2,4-D and 2,4-5-T for the control of horse-nettle in orchards. Davidson, J. H. During the past 2 years foliage sprays of 2,4-D and 2,4,5-T containing 2000 ppm of the isopropyl esters were applied as a wetting spray on horsenettle (Solanum carolinense) at various stages of growth. Best control was obtained when the nettle was sprayed during the late blossom period just as some of the small horsenettle fruits were beginning to form. Sprays applied earlier were ineffective. Observations made the same season as spraying were often misleading as the full effects were not apparent until the following season. Comparative applications of 2,4-D and 2,4,5-T this season applied August 5 during the late blossom period showed much better immediate kill from the 2,4,5-T application. Observations made in October indicated that stems and many roots were dead on the 2,4-5-T treated plots whereas the roots and stems of the 2,4-D plots were still green and succulent. (Contribution of The Dow Chemical Co., South Haven, Mich.)

Final evaluation on the effect of foliage sprays of 2,4,5-T and 2,4-D applied at various periods on poison ivy during the summer of 1948. Davidson, J. H. During 1948 foliage sprays containing 2000 ppm of 2,4-D as the isopropyl ester, the amine and sodium salts and the isopropyl esterof 2,4-5-T were applied as wetting sprays to poison ivy (Rhus toxicodendron) under apple trees. Applications were made at two weeks intervals throughout the summer. Sprays were applied with a power sprayer at reduced pressures using a nozzle which gave a corase fan type spray. Best kill was achieved with 2,4,5-T applied August 25, 1948. Applications of 2,4,5-T made June 16 were almost as good but the applications made during July and early August showed a greater amount of regrowth. Of the 2,4-D formulations the ester and amine salt were the best but were definitely inferior to 2,4,5-T . (Contribution of The Dow Chemical Co., South Haven, Mich.)

A study on the use of 2,4-D for weed control in strawberries. Nylund, R. E. Single applications of isopropyl ester of 2,4-D at 1 lb. acid per acre or sodium salt of 2,4-D at 3 lbs. and 4 lbs. acid per acre made on July 9, 1948 satisfactorily controlled the broadleaved weeds present (principally Amaranthus retroflexus and Portulaca oleracea) for the remainder of the growing season. Two applications (on July 9 and August 11) of the isopropyl ester at 1/4 lb. and 1/2 lb. acid per acre per application and of the sodium salt at 1 lb and 2 lbs. acid per acre per application also gave satisfactory weed control. None of the above treatments had a detrimental effect on leaf production or on runner plant formation in 1948. In 1949, each of the seven above-mentioned herbicide treatments were repeated on five of the ten replications in the test. The 1949 treatments were applied on June 6 at which time most of the crop was set, some fruits being as large as 1 inch in diameter and only a few blossoms were present.

All fruit from both the 1948 treated and the 1948 and 1949 treated plots and check plots were harvested during the period from June 14 through June 29. Neither the 2,4-D applications made in 1948 or those made in 1949 had a detrimental effect on yields of fruit. (Paper No. 675 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota).

Further study on the control of common chickweed (Stellaria media,L.) in strawberries with IPC and its effect on the plants. Carlson, R. F. In the fall of 1948 four concentrations of IPC (5,10, 15, and 25 pounds per acre) were applied to chickweed (Stellaria media, L.) growing in Premier and Robinson strawberry plantings. The material was applied as a dust and spray in September, October and November. The soil at both locations was of the Coloma type. At first it appeared that the September applications gave satisfactory control of the chickweek, however, observations in the early spring (1949) indicated that the October andNovember applications of PIC also gave favorable control. At 5 pounds per acre about 85% of the chickweed was killed, at 10 pounds 95%, and at 15 and 25 pounds per acre 100%. The data indicated some reduction in yield and apparent injury to the strawberry plants at the high rate (25 pounds) per acre, whereas, the yield from the 5, 10 and 15 pound applications compared to the untreated plants. Strawberry plants were dug from the treated areas two months after application and grown in the greenhouse. These grew and fruited and compared favorably to untreated plants. Again some injury in the form of blackening of the roots and reduced yield was noted at the high rate of PIC. (Contribution of Department of Horticulture, Michigan State College, East Lansing, Michigan).

Response of seedling strawberries to 2,4-D. Viehmeyer, Glenn. The isopropyl ester of 2,4-D at the rate of 1 1/2 lbs. of acid per acre was applied to 1500 seedling strawberries of the parentage Evermore X Cheyenne 1229. These seedlings had been planted to the field April 30 and treatment was applied June 28. Rate of application was 10 gallons per acre. Considerable variation was noted between individual seedlings but no seedlings were killed by the treatment. Immediately after treatment some wilting of plants and considerable twisting of pteioles and runners was apparent. Tips of a few runners were killed and the more susceptible seedlings showed root proliferation of both established plants andof the bases of the unrooted runner plants. Recovery was rapid and plants appeared normal at the end of three weeks. Everbearing seedlings fruited normally. The use of 2,4-D for the control of broad leaved weeds in the newly set strawberry bed appears practical. Contribution of the North Platte Experiment Station of the Uni of Nebraska.

Project VI RESUME OF 1949 PROGRAM MADE IN RESEARCH ON ERADICATION OF WOODY PLANTS Summary

Chemical treatment is rapidly replacing mechanical methods in destroying woody plants. This is especially true in areas where it is not necessary to remove the brush and trees before they are killed. Thousands of miles of rights-of-way, thousands of acres of rangeland, and millions of alternate hosts for plant diseases now are being treated with chemicals each year. The use of chemicals in place of mechanical means has materially reduced the cost of eradicating these undesirable woody plants. From the apparent "kills" that have been obtained through the use of chemicals by large-scale operators, as well as through field experimentations, it appears safe to predict that within the next few years the killing of woody plants with chemicals will become much more general. This might seem like too much optimism when we consider that only a start has been made in the research to improve both the chemicals and the methods used in killing woody plants. Despite the fact that workers have much to learn about chemical eradication, the satisfactory results obtained by large-scale operators present an optimistic picture. For example, in last year's summary, Mr. F. A. Ashbaugh of the West Power Company, Pittsburgh, Pennsylvania, who has had success in controlling woody plants with 2,4-D and 2,4,5-T along rights-of-way, was quoted. This is his comment for 1949: "We have been checking last year's list against the new year's results, and we are not willing to change any of the conclusions we furnished you last year."

Each year the selectivity of 2,4-D (2,4-Dichlorophenoxyacetic acid) is becoming more clearly defined as a result of repeated tests and extensive field use. Experience is proving that higher concentrations of 2,4-D or 2,4,5-T (2,4,5-Trichlorophenoxyacetic acid) are required for killing woody plants than are needed for killing herbaceous plants. There appears to be a tendency to use higher concentrations, which might improve the efficiency of the kill. On the other hand, increasing concentrations of formulations will not kill tolerant species of plants.

For general brush spraying, mixtures of 2,4-D and 2,4,5-T seemed to be the more effective. Formulations of 2,4,5-T killed some species of plants that are tolerant to 2,4-D, while some species were tolerant to both chemicals. From reports received, it is not necessary to have equal parts of each in the formulation to obtain a good "kill." Some effective herbicidal formulations contained two parts of 2,4-D to one part of 2,4,5-T.

Chemical companies have made some excellent advances in manufacturing new proprietary formulations of 2,4-D, 2,4,5-T, and combinations of the two. Some have been more effective than formulations previously put on the market. However, there is still much room for improvement in chemical formulations. Some ester formulations should be rendered less volatile. Improvements in penetration and translocation properties should be made. There is still considerable sprouting of treated plants. New herbicides that will kill woody plants with one application are needed.

Up to the present time, formulations of 2,4-D and 2,4,5-T have been used mostly as foliage sprays. For most species of woody plants, the most effective "kill" is obtained when the plants are sprayed when they are in the succulent stage. However, some sensitive types are killed when the foliage is sprayed even in the late summer or pre-dormant stages.

Since the season for effective foliage spray is relatively short, experiments designed to perfect techniques for applying 2,4-D, 2,4,5-T, or a combination of the two that will kill plants at any season of the year, are now in progress. For brush, relatively concentrated chemical formulations in either oil or water are applied as

sprays to either the whole bush or the base of the canes at any season of the year. Some progress has been reported in killing shrubs by spraying them in the dormant stage. Trees are treated by spraying relatively concentrated (1, 2, or even a higher percent) 2,4-D, 2,4,5-T, or both to the base of the trunks. Preliminary results are encouraging. However, it is hoped that more experimental results on dormant sprays will be available in another year.

Chemicals, such as sodium chlorate, borax, common salt, ammonium sulfamate, and others, still have their place in the chemical-eradication picture. Amate is useful as a spray for killing some plants, and it is especially useful when the dry salt is applied to cut surfaces. It is used to prevent sprouts from developing on tree stumps. Sodium chlorate and borax are useful for certain "special spot" treatments.

Some progress was made during 1949 on some of the "problem" plants. In 1948, encouraging results were reported, indicating that an economical method had been found for controlling sandsage on the range. This year, Messrs. Fisher and Young from Spur, Texas, report hopeful progress in killing mesquite with foliage sprays. "The most effective treatments have been those applied shortly after mesquite comes into full leaf. . . . The ester of 2,4,5-T, applied at the rate of 1 pound per acre in 20 gallons of carrier, has been the most effective treatment. When the mesquite is actively growing, emulsions have proved superior to oil solutions; but in dormancy the only effective treatment is the ester of 2,4,5-T applied in 20 gallons of oil per acre. The esters and amines of 2,4-D have shown little effect on mesquite when it is actively growing and no effect when the mesquite is in the dormant stage. Combinations of the esters of 2,4-D and 2,4,5-T have shown results commensurate with the amount of 2,4,5-T present, except in the case of 1 to 2 ratio of the butoxy ethanol esters of 2,4,5-T and 2,4-D." These authors also report progress in killing mesquite by the cut-surface treatment technique. No extensive or conclusive data were received concerning killing the large sage, Artemisia tridentata, with 2,4-D or 2,4,5-T.

Buckbrush (Symphoricarpos spp.) eradication is still a knotty problem. There appears to be a difference between the sensitivity of Symphoricarpos orbiculatus and S. occidentalis to 2,4-D. Although few reports were received concerning the former, some workers think that B. orbiculatus appears to be more sensitive to 2,4-D than the B. occidentalis. Both appear tolerant to 2,4,5-T.

Progress is being made in killing osage orange (Maclura pomifera) with foliage sprays of 2,4,5-T. This chemical also is specific for killing blackberries and other species of Rubus.

Hawthorns (Crataegus spp.) are a problem, but some success (though not consistent) in killing them was reported. The flower-bud and full-bloom stages appear to be most sensitive to 2,4-D and 2,4,5-T.

Wild roses (Rosa spp.) appear very tolerant to both 2,4-D and 2,4,5-T. Some successful treatments were reported, but there is still a great lack of data on which to base any kind of recommendation.

In our 1948 summary, we reported that selectivity of "2,4-D was proving a useful tool in eliminating competitive, useless shrubs and trees that impair the successful regeneration and growth of valuable forest trees." Your attention is called to an abstract by Dr. Henry Hansen of the University of Minnesota, entitled "The effects of 2,4-D sprays on eastern white pine (Pinus strobus L.) seedlings growing under hazelbrush." The data in this abstract indicate that 2,4-D used in treating hazelbrush kills one-year-old pine seedlings and probably reduces the

viability of pine seeds on the ground. It is obvious that further research is necessary to perfect a technique that will enable 2,4-D to kill hazelbrush but not harm young pine seedlings.

Helicopters were used successfully for spraying herbicides on woody plants. Messrs. H. R. Offord and V. T. Moss, Bureau of Entomology and Plant Quarantine, U.S.D.A., reported on treating Ribes spp. with 2,4-D sprayed from a helicopter. Mr. C. C. Butler of the Bureau of Reclamation, U.S. Department of the Interior, reports preliminary results of spraying willows along irrigation ditches with a helicopter.

In most cases complete eradication with one treatment is desired when killing woody plants with chemicals. It is now necessary to retreat regrowth on many woody plants to get complete "kill." This would indicate that more effective chemicals, formulations, or combinations must be evolved that will give a complete "kill" with one treatment. Continued basic research on herbicides is fundamental to increasing our knowledge of killing woody plants. More research and experimentation is needed on year-round spraying with 2,4-D, 2,4,5-T, and similar chemicals. Penetrants and similar materials should be tested thoroughly to step up penetration and translocation of herbicides.

The abstracts and "plant-reaction" tables from which this brief summary was made were received from a wide range of territory. Abstracts were received from eight different States in the United States and from four Provinces in Canada. Data concerning the reactions of woody plants to 2,4-D, 2,4,5-T, and a combination of the two chemicals were contributed from fifteen States and two Provinces. The latter data were gathered in areas that would represent all of the general ecological conditions in the United States, with the exception of New England, Florida, and the Pacific Coast. The subcommittee is grateful to all of those research workers who sent in contributions to make this report possible.

Since each year's experience with the various formulations of chemicals produces data that can be added to that of previous years to furnish additional background for definite recommendations, it is urged that all workers send in post-range data each year. This should be done in spite of the fact that there might be a repetition of the previous year's data.

There are no 1949 data for some species of plants that were included in the 1948 report. Space would not permit including these 1948 data in the 1949 report to make more inclusive "plant-reaction" reports.

Subcommittee on eradication of woody plants
L. W. Molander, Chairman

Project VI

A B S T R A C T S

Submitted to
Subcommittee on Research
in Eradicating Woody Plants

North Central Weed Control Conference
1949

Selective herbicides valuable for converting Black Jack-oak land to Grass.1/ Elwell, Harry M.2/ There is a lot of useless brushland scattered over the country, about 18 million acres of which is in the Red Plains. Much of it is located on shallow, highly erosive soil. It is, therefore, important that a continuous protective cover be maintained on this land. But, where selective herbicides are properly used, the land cover is not destroyed. Leaves, twigs, and stems of Black Jack and other oak brush sprayed with mixtures of 2,4-D and 2,4,5-T all accumulated in a mulch on the soil at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma. There was an average of 7,593 pounds per acre of litter two years after treatment. This mulch conserves water and makes conditions ideal for the growth of grass. Big bluestem and other native grasses developed rapidly after the brush was killed. They grew largely from the few spindling plants intermingled in the brush. The yield of grass in 1949 was 2,836 pounds per acre from the plots sprayed in the spring of 1947. This yield was equal to that of virgin meadows. Grass is more effective for erosion and flood control than the original cover of brush and grass. In fact, measurements made the last eight years show that 45 percent less water ran off annually from good grass on cleared land than from an adjacent area of brushland.

Effect of 2,4-D and 2,4,5-T on woody growth. Wood, H. E., Bourns, J. J., Fuller, J. C. E., Shanks, G. L., and Playfair, L. G. Field trials, in which a turbine was used to apply the chemical, were conducted on mixed woody growth at two locations near Winnipeg. Plots were 88 by 11 yards, with checks between each. White poplar (Populus tremuloides), willow (Salix spp.), and bur oak, (Quercus macrocarpa) predominated, with hawthorn (Crataegus spp.), hazel (Corylus spp.) saskatoon (Amelanchier alnifolia), wild rose (Rosa spp.) and dogwood (Cornus stolonifers) scattered throughout. Growth ranged from 5' to 15' in height, which made uniform coverage difficult. The esters of 2,4-D and 2,4,5-T were used singly and in combination, also several "brush kills" (a combination of 2,4-D and 2,4,5-T) at 1 lb. and 2 lbs. acid per acre, also one plot of amine at 2 lbs. Water was used as a carrier at 5, 10, and 20 imperial gallons per acre; 5 gallons Diesel fuel was substituted for water, also 5 gallons water with the addition of 10% Diesel fuel. Spraying was carried out on one series of plots June 7, the other June 23. Trees were in full leaf. Apparent kills ranged from 50% to 85%. Bur oak was resistant to all treatments; likewise wild rose, except where 2,4,5-T was added or where "brush killers" were used. Conclusions drawn from these trials were: (1) as water was increased from 5 to 20 gallons, decidedly more satisfactory results were obtained--better penetration and coverage; (2) the substitution of 5 gallons oil for 5 gallons water showed no improvement--questionable if as satisfactory; similarly the addition of 10% oil to water; (3) the advantage of the addition of 2,4,5-T was on species (wild rose) resistant to 2,4-D; where 1 lb. acid was applied, and a portion of this

1/ Contribution from Oklahoma Agricultural Experiment Station and Soil Conservation Service, Research. Abstracted from Oklahoma Agricultural Experiment Station Bulletin B-335 and Mimeographed Circular M-181.
2/ Soil Conservationist, Red Plains Conservation Experiment Station, Guthrie, Oklahoma.

was 2,4,5-T, less satisfactory kills were obtained on susceptible species than where 1 lb. 2,4-D was used; (4) in general the several "brush kills" used at 1½ and 2 lbs. acid per acre with 10 and 20 gallons water gave the most satisfactory results; and (5) 1½ lbs. acid per acre appears to be about the optimum amount of chemical to use. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, co-operating with the University of Manitoba, and the Manitoba Power Commission, Winnipeg, Canada.)

Comparison of the effects of 2,4-D, 2,4,5-T, and Stoddard solvent sprays on seedlings of Black Locust (Robinia pseudoacacia L.)1/ Hansen, Henry L. and Pelton, John F. Seven and one-half week old seedlings of black locust, grown in flats in the greenhouse during April and May, were sprayed by a hand atomizer with herbicides, at concentrations and volumes as specified in the table. Survival percentages at the end of one month are averaged for each test from triplicate flats.

	Volume (per acre basis)	Concentration (parts per million of the acid equivalent)	Quantity of herbicide (per acre basis)	Initial No. of seedlings	Average survival after 30 days - (%)
2,4-D (using Weedone concentrate #48)	20 gal. per acre	400 ppm	1 lb.	77	22.7
		800 ppm	2 lbs.	74	1.5
		1600 ppm	4 lbs.	88	0
2,4,5-T (ester form)	"	800 ppm	2 lbs.	82	0
Stoddard solvent	"	full strength	about 150#	78	87.9

The seedlings were in a rather succulent, rapidly growing stage. The temperature during the afternoon of the treatments averaged about 74°F in the greenhouse, and the relative humidity was near 37 percent. The leaves of the Stoddard solvent-treated plants appeared dead within 24 hours. The leaves of the 2,4,5-T treated plants, and those of the 400 ppm 2,4-D sprayed seedlings showed only various degrees of twisting within the same period. The higher concentrations of 2,4-D, however, resulted in numerous whitish, coalescing leaf lesions in addition to twisting. Although the initial injury by 2,4,5-T appeared to be less than that from equal concentrations of 2,4-D, in less than a week all the seedlings in the 2,4,5-T treated flats were completely dead. The 1600 ppm 2,4-D also resulted in almost complete mortality by this time, while the relatively numerous surviving plants under the 400 and 800 ppm 2,4-D displayed a conspicuous swelling of all parts of the stem and main root. At this time the seedlings sprayed with Stoddard solvent were beginning to develop lateral shoots from their lower buds, although almost all their foliage had been killed. At the termination of the experiment, one month after spraying, the seedlings sprayed with Stoddard solvent appeared almost normal and the few survivors left after the 2,4-D treatments were beginning to develop healthy lateral shoots from their lower buds.

Effect of herbicides on woody growth. Friesen, H. A. During 1949 the ester and amine of 2,4-D and ester of 2,4,5-T were applied separately as foliage sprays on western snowberry (Symphoricarpus occidentalis) and prairie rose (Rosa spp.) at

1/ Published with the approval of the Director as Paper No. 674 of the Journal Series of the Minnesota Agricultural Experiment Station.

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previous year in that only one out of six trees showed regrowth at the base while the June 1948 treatment only had five out of seven trees with regrowth. By September 26 there were some new shoots at the base of most trees. Shoots were most vigorous in portions of plots having a single spring treatment in 1948. Plots given an initial treatment of 12,000 ppm and 4,000 ppm thereafter showed no advantage over those treated with 2,000 ppm 2,4,5-T by September 26, 1949. Ammonium sulfamate killed approximately three-fourths of the tops, with some advantage for the repeated fall treatments, but the central portion of the trees was a dense mass of live shoots and leaves. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.)

Observed difference in drifting of high and low volume spraying of brush. Klingman, Dayton L. and Shafer, Neal E. In an experiment comparing various rates of application of 2,4,5-T and 2,4-D on Osage orange there were also included preliminary treatments in which lower volumes per acre were used. There was a rather strong breeze directly parallel with the Osage orange hedge row, and the amount of vegetation killed past the end of the plots could be observed in the check next to the high volume (160 gallons per acre) and at the end of the experiment next to the low volume (16 gallons per acre) treatment. The actual distance of spray drift is not known, but the relative killing effects on leaves beyond the end of the treated plots was noted. In untreated plots next to the 160-gallon-per-acre volume, severe injury was noted 10 feet beyond the treated plot. Where the 16-gallon-per-acre volume was used, severe injury was observed to extend 50 feet beyond the treated plot. This would indicate that toxic quantities of the herbicides had drifted five times as far when applied in 16 gallons of water per acre as when applied in 160 gallons of water. Two weeks after spraying the low volume treatments looked equally as effective as the 160-gallons-per-acre treatments. The relative actual kill will not be determined since these plots have since been bulldozed. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A., and the Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska).

Comparison of 2,4-D and 2,4,5-T for control of buckbrush (Symphoricarpos occidentalis). Klingman, Dayton L. The ethyl ester of 2,4-D and 2,4,5-T was sprayed on eight by ten foot plots of buckbrush June 4 and July 13, 1948, at rates of one- and two pounds acid in 40 gallons of water per acre. Plots located near Lincoln, Nebraska. 2,4-D was greatly superior to 2,4,5-T for control of buckbrush, giving an average control of 64 percent and one percent, respectively, according to notes taken on June 2, 1949. 2,4-D sprayed June 4, 1948, at one pound gave 75 percent control, two pounds gave 66 percent; 2,4-D sprayed July 13, 1948, at one pound gave 68 percent control and two pounds gave 55 percent (biased upwards by only five percent control in one replication). Differences between rates and dates of application above were not statistically significant. 2,4,5-T treatments gave 2 percent or less control at all rates and dates. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.).

Effects of 2,4-D sprays on eastern white pine (Pinus strobus L.) seedlings growing under hazelbrush. Hansen, Henry L. One of the important factors which must be considered in the application of herbicides to control brush on forest areas is the degree to which injury will occur to any desirable tree reproduction which may be present. Data relative to this problem were obtained from a series of plots at Itasca State Park, Minnesota, on which the hazelbrush was sprayed on July 19, 1949, using three different concentrations of a 2,4-D spray. The density of hazelbrush varied from 4,400 stems per acre on the plot with the least brush to 28,700 on the most brushy plot. At least 100 eastern white pine seedlings, varying from 1 to 7 years in age were found growing under the hazelbrush on each of the 10 mil-acre quadrats. All sprayed plots had almost complete mortality of the white pine seedlings which had originated in the 1949 growing season (classed as 1-year seedlings).

dosages of 1/2, 1, and 2 pounds of acid per acre. One application was made in mid-June. Complete defoliation of western snowberry with no sign of recovery in 1949 resulted from the 1 and 2 pound rates of the amine and ester of 2,4-D and 2,4,5-T. The 1/2 pound rates of these formulations resulted in 90 percent defoliation; however, 10-15 percent of the defoliated plants had sent up new shoots by late September. While the prairie rose was not affected by any of the rates of 2,4-D, it was completely defoliated by all rates of 2,4,5-T. A mixed population of western snowberry, prairie rose, and silverberry (Eleagnus comutata) was treated in mid-June with two mixtures, viz: (1) 1 pound butyl ester /2,4-D? Ed./ and 1/2 pound 2,4,5-T, and (2) 1 pound butyl ester and 1 pound 2,4,5-T per acre. Complete defoliation of all three species, with no signs of recovery in 1949 resulted. The rates of 2,4-D and 2,4,5-T given in paragraph 1 were sprayed on western snowberry and silverberry in 1949.* In early June 1949 all plots of snowberry showed up to 15 percent regrowth. Plots of silverberry had not leafed out but the wood was not yet dried and completely dead. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949).

Effects of 2,4-D, 2,4,5-T, and their mixture, on woody growth. Corns, W. G. Aspen poplar (Populus tremuloides), Buckbrush (Symphoricarpos occidentalis), Roses (Rosa acicularis, R. Arkansana), Saskatoon (Amelanchier rotundifolia), Willows (Salix Bebbiana, S. discolor, S. petiolaris) along fence line were treated for first year. Experiments 1 and 2: 2,4-D (Green Cross butyl ester), 2,4,5-T (Naugatuck isopropyl ester), 2,4-D, 2,4,5-T mixture (A.C.P.#32 butoxy ethanol ester) applied June 28 at rates 2 and 3 lbs. acid equivalent in 75 gallons of water and in 150 gallons water/acre. In Experiment 3, 2 lbs. 2,4,5-T and 4 lbs. 2,4-D in 75 gallons water/acre applied on July 15 to similar vegetation. In Experiments 1 and 2, top-growth of willows and Saskatoon was completely killed by each chemical at both rates. Damage was most rapid where the larger amount of water was used, but final results from use of 75 gallons were equivalent to those from 150 gallons/acre. Within 2-3 weeks top-growth of roses was completely killed by 2 lbs. 2,4,5-T, and within 3-4 weeks by same rate of Brush Killer per acre. Roses only partially affected by 3 lbs. of 2,4-D per acre. In all treated areas there was about 2 percent regrowth of roses, and no current regrowth of other species. Buck-brush and poplar showed variable response to all chemicals but, in general, 2,4,5-T at 3 lbs. per acre was the most effective against poplar. Results from Experiment 3 again showed superiority of 2,4,5-T against roses. Two pounds of 2,4,5-T per acre caused complete kill of top growth, while 4 lbs. of 2,4-D produced only 50-75 percent damage to roses. (Contributed by Department of Plant Science, University of Alberta).

Comparison of 2,4-D, 2,4,5-T, and ammonium sulfamate as second season applications in the control of Osage orange. Klingman, Dayton L. Original treatments June 2, 1948, of 12,000 ppm, 2,000 ppm,, and 1,000 ppm. each of 2,4-D and 2,4,5-T, and 1/2 pound of ammonium sulfamate per gallon all applied at 160 gallons per acre and the results of the first season were reported in Abstract VI-1 of the North Central Weed Control Conference Research Report, 1948. One-half of each 50-foot plot was again sprayed September 28, 1948, with the rates used in June, except that 4,000 ppm was substituted for the 12,000 ppm. All of the above rates and materials were again applied to the respective original plots on June 23, 1949. Notes taken May 29,1949, were quite encouraging. Notes taken later in the season were not so optimistic. In general, early in the season all 2,4,5-T treatments of 2,000 ppm or greater showed 95 percent or better of the top growth killed and only moderate regrowth, while all treatments with 2,4-D were relatively ineffective. The 1,000 ppm treatments of 2,4,5-T gave 65 to 95 percent top kill, but all trees were sending out new shoots at the base. These shoots were killed by the spray June 23, 1949, but by September 29 most trees again had shoots from 6 to 48 inches tall. The 2,000 ppm of 2,4,5-T by May 29 gave a differential in favor of the repeated treatments of the

*In early June 1949 all plots of snowberry showed up to 15 percent regrowth.

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In contrast, the unsprayed check plots had an average of only 54 percent mortality of 1-year seedlings. The mortality of seedlings older than 1 year on sprayed plots averaged 30 percent. On the check plots the mortality of these older than 1-year seedlings was only 19 percent. On the 3 unsprayed control plots, a total of 77 seedlings germinated sometime between the original and the second plot counts. On the 3 sprayed plots only 5 such seedlings germinated. This would seem to indicate that the spray treatments either reduced the viability of the pine seeds on the ground or else that the spray residues were effective over a considerable period of time and injured the newly germinating seedlings as they emerged.

Mortality of eastern white pine seedlings growing under hazelbrush sprayed with 2,4-D

Plot No. 1/	Spray (ppm) 2/	1-year seedlings: No. before spraying 3/	1-year seedlings: Mortality: Number	1-year seedlings: Mortality: Percent	Seedlings over 1-yr.old: No. before spraying 3/	Seedlings over 1-yr.old: Mortality: Number	Seedlings over 1-yr.old: Mortality: Percent	Seedlings germinating after 1st plot counts
T1	18,000	167	160		15	0		3
T2	9,000	130	130		10	3		0
T3	6,000	53	52		64	24		2
Total		350	342	98	89	27	30	5
C1	None	115	79		19	1		51
C2	"	112	86		12	1		17
C3	"	89	5		70	17		9
Total		316	170	54	101	19	19	77

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Use of 2,4-D in eradication of poison ivy (Rhus radicans var. Rydbergii) in northern Minnesota.1/ Hansen, Henry L. The frequent and often serious ivy poisoning of students at the University of Minnesota forestry summer camp at Itasca State Park led to attempts to eradicate the ivy on the camp and lakeshore area in the summers of 1948 and 1949. The practical success of the use of 2,4-D foliage sprays in this connection is indicated by the fact that no serious ivy poisoning was reported by the entire group of 60 students during the camp period in 1949. All concentrations down to the lowest tried (2250 ppm) gave satisfactory kill of the ivy under the Itasca conditions. A minor amount of resprouting occurred in 1949 on many of the areas sprayed in 1948 and on which 100 percent stem kill was noted in 1948. There seemed to be more resprouting under the shade than in the open.

1/ All plots 0.3 acres in size. Seedling counts made on 10 mil-acre quadrats in each plot.
2/ Foliage spray using 2,4-D as an ethyl ester in water. Rate of application was 3 lbs. (acid equivalent) per acre on all sprayed plots.
3/ Spraying done July 19, 1949, using an Indian back pump with adjustable fog nozzle.

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Date Sprayed	2,4-D Concentration (ppm)	Ivy Mortality as indicated by 1/ First Season counts (percent)	Second Season counts (percent)
June 16, 1948	352,000 (ethyl ester)	100	97
June 16, 1948	187,500 " "	100	100
June 17, 1948	18,750 " "	95	75
June 30, 1948	9,375 " "	100	90
July 2, 1948	4,500 " "	100	75
July 2, 1948	4,500 " "	100	100
July 2, 1948	4,500 " "	100	85
July 2, 1948	2,250 " "	100	85
June 22, 1949	4,500 (isopropyl ester)	100	--
June 22, 1949	4,500 " "	100	--
July 1, 1949	4,500 " "	100	--

Effect of 2,4,5-T and 2,4-D singly and in combination on Osage orange sprouts and stumps. Zehnley, J. W., and McCall, G. L. Formulations of 2,4,5-T and 2,4-D were applied separately and as mixtures to hedge sprouts July 13, 1949. Additional applications of the mixtures were made to new plots on August 22. The hedge sprouts came from fragments of roots of an established hedge-row which had been completely uprooted by a bulldozer leaving no stumps. The sprouts had grown to a height of 4 to 8 feet in 1948 and were cut off 4 to 12 inches above the ground in the early spring of 1949. At the time of treatment the sprouts ranged from 2 to 4 feet high and were growing vigorously. Applications of 2,4,5-T alone at 3,000 and 6,000 ppm and in mixtures with 2,4-D at comparable rates killed all growth produced in 1949 and damaged the stumps from which this growth originated. Mixtures of 25 percent 2,4,5-T and 75 percent 2,4-D in concentration of 3,000 ppm appeared to give about as good kill as a 50-50 mixture at the same concentration, although the action appeared to be somewhat slower. The 50-50 mixture of 2,4-D and 2,4,5-T in concentration of 3,000 ppm appeared to be as effective as the same concentration of 2,4,5-T alone, or a 75 percent 2,4,5-T mixture with 2,4-D. Applications of 2,4-D alone in concentrations of 3,000 ppm or 6,000 ppm killed only the growing tips, leaving the remainder of the foliage free of noticeable damage. It is possible that a concentration of 2,4,5-T considerably lower than 3,000 ppm might be effective on Osage hedge and that there is little or no advantage in the addition of 2,4-D. Lower concentrations of 2,4,5-T alone should have been included in the above experiments to determine this. (Contribution of the Kansas Agricultural Experiment Station.)

Symptoms resembling 2,4-D injury on Acer negundo. Sackston, W.E., Wrinkling, chlorosis, and distortion of the veins of young leaflets were observed on secondary growth and seedlings of Acer negundo early in August, 1949. Earlier growth was not affected. Some of the affected shoots apparently recovered, while others died. Injury was observed only occasionally on tertiary shoots late in the season. The disorder was present throughout the agricultural area of Manitoba and eastern Saskatchewan, and was reported from wooded areas of north-eastern Saskatchewan, 25 to 50 miles from agricultural settlements. It was reported also affecting several seedlings and new growth from an old stump at Brookings, South Dakota. The symptoms were typical of 2,4-D injury. Affected shoots occurred in many locations distant from fields known to have been treated with 2,4-D. The

1/ The difference between first and second season counts indicates re-sprouting.

distance in some cases was so great that the damage could not have been due to normal drift of the chemical. Occurrence of the symptoms was so widespread and general that they could be attributed to 2,4-D only if fumes of the chemical were assumed to be present over great areas in sufficient concentration to affect young leaves of Acer negundo. Tomatoes present in some of the localities apparently were not injured. The possibility that the symptoms were caused by a severe frost throughout the area late in May is lessened by their occurrence on young seedlings that had not emerged at the time of the frost. (Contribution from the Dominion Laboratory of Plant Pathology, Winnipeg, Manitoba, Canada.)

Dormant season treatments of brush with 2,4,5-T shows promise. Coulter, L. L. The isopropyl ester of 2,4-D and 2,4,5-T alone and mixtures containing equal amounts of each were applied to standing brush in mid-February 1949. Concentrations of 8,000 and 16,000 ppm in fuel oil were applied as base sprays (knee high) and as overall sprays. The lower concentrations of 2,4-D regardless of method of application produced some formative effects but control was generally unsatisfactory. A fair degree of control was obtained with the 16,000 ppm concentration. In contrast, 8,000 ppm of 2,4,5-T gave nearly complete control of such species as oak, ash, cherry, and complete top kill was obtained on basswood. 16,000 ppm of 2,4,5-T did not appear to be superior to 8,000 ppm. Plots treated with 2,4,5-T failed to produce leaves in the spring, while all plots treated with 2,4-D or 2,4-D / 2,4,5-T mixtures did produce leaves, some of which died during the course of the summer. 8,000 ppm of 2,4,5-T was approximately equivalent to 16,000 ppm of the mixture containing 50 percent of each. While some late season regrowth occurred in the 2,4,5-T plots, 8,000 ppm of this material in fuel oil applied as a base or overall spray was comparable to one standard foliage treatment and shows much promise for dormant season treatment. (Contribution of The Dow Chemical Co., South Haven, Michigan).

2,4,5-T improves control of stumps sprayed during dormant season. Coulter, L. L. A mixture of oak and maple stumps ranging in size from 4 inches to 27 inches was sprayed with fuel oil mixtures containing 4,000, 8,000, and 16,000 ppm of the isopropyl ester of each 2,4-D and 2,4,5-T as well as equal mixtures of 2,4-D and 2,4,5-T. The 2,4,5-T plots produced sprouts on 7 percent of the stumps while the 2,4-D plots produced sprouts on 47 percent of the stumps. The mixture containing equal amounts of each permitted sprouting on 4 percent of the stumps. 75 percent of the stumps not treated produced sprouts. There was no greater control where the higher concentrations of any of the chemicals were used. In a similar test on maple stumps averaging 6 inches in diameter where only 4,000 and 8,000 ppm concentrations were used, 2,4,5-T was again outstanding. No sprouts emerged from any stump treated with either concentration of 2,4,5-T or the 2,4-D / 2,4,5-T mixture. Where 2,4-D alone was used, 84 percent of the stumps produced sprouts. These tests seem to demonstrate the importance of 2,4,5-T in a dormant stump control program and the results are consistent with other tests carried out on a similar basis. (Contribution of The Dow Chemical Co., South Haven, Michigan).

Use of herbicides in controlling woody perennials in rough pasture. Leefe, J. S. Brush in a rough pasture was sprayed in mid-June with a mixture of 2,4-D and 2,4,5-T each at a concentration of 3,000 ppm. The following species were killed: graybirch (Betula populifolia), blueberry (Vaccinium sp.), and bayberry (Myrica pensylvanica). The following showed severe injury but recovered: bracken fern (Petridium aquilinum), juniper (Juniperus communis), sheep laurel (Kalmia angustifolia), shodora (Rhododendron canadense), and hawthorn (Crataegus sp.). The following were not injured by the treatment, wild lily of the valley (Maianthenum canadense), teaberry (Gaultheria procumbens), wild rose (Rosa sp.), wild strawberry (Fragaria virginiana), and bunchberry (Cornus canadense). (Contribution of Dominion Experimental Station, Kentville, Nova Scotia).

Effect of mesquite control on gains of yearling steers. Fisher, C. E., and Marion, Paul T. Grazing studies have been conducted since 1945 during the summer months on 4 pastures cleared of a moderate stand of mesquite and on 4 uncleared pastures. Control of mesquite has increased steer gains an average of 27 pounds per head for the five-year period of study, an increase of 15.08 percent. In 1948, a year with below normal rainfall, steer gains were 40 percent greater on pastures cleared of mesquite. In addition to the increased steer gains obtained on cleared pastures, much less labor has been necessary for handling livestock. Furthermore, the condition of desirable forage on cleared pastures has improved markedly when compared to that on uncleared pastures. (Contributed by the Texas Agricultural Experiment Station and the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, Spur, Texas.)

Cut-surface applications of herbicides to mesquite (Prosopis juliflora). Fisher, C. E., and Young, Dale W. Most available herbicides have been sprayed on the cut surfaces of mesquite and painted on the exposed sapwood with a paint brush. Treatments have been made at different seasons of the year with apparently equal success during 1948 and 1949. The most effective treatments are painting the cut surface of the stump with the amine of 2,4-D at a concentration of 4 pounds per gallon, and spraying the freshly cut stumps with a 1-percent-acid-equivalent solution of the ester of 2,4,5-T in diesel oil. Spray solutions of the salts of 2,4-D in water or in a water-oil emulsion were not effective. Twice the concentration of the ester of 2,4-D in oil was needed to be as effective as the ester of 2,4,5-T in oil. Approximately twice the concentration of the ester of 2,4-D and 2,4,5-T are required when they are applied in a water or a water in oil emulsion as compared with the esters in oil. (Contributed by the Texas Agricultural Experiment Station and the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, Spur, Texas).

Treatments to the foliage of mesquite (Prosopis fuliflora) with ground equipment. Young, Dale W., and Fisher, C. E. Most available herbicides have been applied to the foliage of mesquite at all seasons of the year. The most effective treatments have been those applied shortly after the mesquite comes into full leaf. Water, oil, water and oil emulsions and various penetrating agents have been used as carriers. The ester of 2,4,5-T applied at the rate of 1 pound per acre in 20 gallons of carrier has been the most effective treatment. When the mesquite is actively growing, emulsions have proven superior to oil solutions; but in dormancy the only effective treatment is the ester of 2,4,5-T applied in 20 gallons of oil per acre. The esters and amines of 2,4-D have shown little effect on mesquite when it is actively growing and no effect when the mesquite is in the dormant stage. Combinations of the esters of 2,4-D and 2,4,5-T have shown results commensurate with the amount of 2,4,5-T present except in the case of a 1 to 2 ratio of the butoxy ethanol esters of 2,4,5-T and 2,4-D. In general, the use of penetrating agents has been discouraging. Sprout growth after reaching approximately 4 feet in height responds similarly to tree type mesquite. A retreatment of sprout growth at a two-year interval has given up to 60 percent permanent kill when made with 1 pound of the ester of 2,4,5-T in 20 gallons of a suitable carrier per acre. (Contributed by the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering and the Texas Agricultural Experiment Station, Spur, Texas.)

Basal application of herbicides to mesquite (Prosopis juliflora). Young, Dale W., and Fisher, C. E. Research has shown that the application of certain herbicides around the base of mesquite to a height of one foot above the soil line is more effective than spraying the foliage with ground equipment. Effective results have been obtained by wetting the bark of a mesquite plant around its base with a .5 percent solution of 2,4,5-T ester in oil. This method was used to treat several acres of mesquite this year and the entire cost, including chemical, oil, and the cost of

application amounted to approximately one cent per tree. This method may be successfully used at any time of the year and lends itself to use in the close proximity to cotton and other susceptible plants. This method shows great promise and can be used on fence rows, scattered trees, and in other areas not lending themselves to airplane application of herbicides. Tests have shown that water solutions and oil in water emulsions of the salts and esters of 2,4-D and 2,4,5-T are not effective in basal applications. The esters of 2,4-D in oil are not consistently effective and the combination of the esters of 2,4-D and 2,4,5-T in oil show an effect commensurate with the amount of 2,4,5-T in the mixture. (Contributed by the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering and the Texas Agricultural Experiment Station, Spur, Texas.)

Airplane application of herbicides to mesquite (Prosopis juliflora). Fisher, C.E., and Young, Dale W. During 1949 airplane applications of herbicides have been made to mesquite in the spring dormant, full leaf, early summer, midsummer, and the fall growth stages of the plant. Herbicides were applied to 5-acre plots in water, in oil, and in 20 to 80 percent water in oil emulsions at the rate of 1½ to 10 gallons per acre. Complete results cannot be ascertained at this time, but certain results are apparent. The application of 2/3 of a pound of 2,4,5-T ester in 5 gallons of a 20-percent oil emulsion per acre in the full leaf stage of growth with ample soil moisture available gave an estimated 90 percent top kill and a 25 percent root kill of mesquite. This treatment also gave a 100 percent kill of annual broomweeds, Russian thistles, sunflowers, etc.; opened the area sufficiently for one to see and drive cattle; and temporarily removed the competition of the mesquite with the grasses for moisture, plant food, and sunlight. As little as 1/3 of a pound of 2,4,5-T ester in 5 gallons of oil gave an estimated 70 percent top kill and some root kill of mesquite when applied in the full leaf stage. In general, the dormant treatments were not successful, but 2,4,5-T in oil showed greater effect than 2,4-D. Even in the full leaf stage the esters and amines of 2,4-D did not give satisfactory control except in the case of one special ester. At the present time it appears that the full leaf stage is the optimum time to spray mesquite and that 4 gallons per acre of a 50-percent water-in-oil-emulsion carrying 2/3 of a pound of 2,4,5-T ester has given best results. (Contributed by Texas Agricultural Experiment Station and the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering, Spur, Texas.)

Effect of 2,4-D and 2,4,5-T on western snowberry (Symphoricarpus occidentalis). Breakey, W. J. A twenty-acre pasture field heavily infested with western snowberry was divided in one-acre plots and treated with ester (Isopropyl), amines, and Esteron 245. Plots were sprayed with a tractor drawn-boom type sprayer. Pressure was maintained at 40 pounds. The three formulations used were applied at two rates, 1 pound and 1½ pounds of acid per acre and the ester and Esteron 245 together at rates of 1/2 pound and 3/4 pounds of acid each. The ester proved effective at both rates. Similar to results obtained with ester in 1948, the heavier rate proved more effective and gave a higher percentage of kill. The amines at both rates gave a low percentage of kill and could not be considered as an effective means of controlling this persistent type of brushwood during the two years spraying. Esteron 245 reacted similar to amines. The amount of kill resulting from the use of Esteron 245 was quite similar to that of the amines. It did not prove effective against the snowberry. Esteron 245 and ester used together, at rates of 1/2 and 3/4 pounds each, resulted in partial killing of the snowberry. The amount of kill was in direct relation to the amount of the ester acid in the mix, as it appeared that the kill resulted from the ester acid. Results obtained from two years' work with esters and amines show that ester used at rates of from 1 pound to 1½ pounds of acid per acre will definitely eradicate western snowberry over a 2-year period, while amines have not proven effective as a means of control or eradication for this type of plant. One year's results - Esteron 245, at rates up to 1½ pounds of acid per acre,

is not recommended for spraying snowberry. (Contribution of the Dominion Experimental Station, Morden, Manitoba.)

Effect of 2,4-D on buckbrush (Symphoricarpos orbiculatus) and poison ivy (Rhus toxicodendron). Woestemeyer, W. W., and Stucky, H. E. Square rod plots of buckbrush were sprayed with 2,4-D at rates ranging from three-fourths to two pounds acid per acre in the ester form and one and two pounds in the amine form on June 16, 1948. The 2,4-D was applied in a water solution at the rate of forty gallons per acre. All the ester plots were completely defoliated in one month except the one-pound plot which took two months. One pound of amine showed no effect, but by early fall leaves on the two-pound amine plot had turned yellow. In the spring of 1949 all ester plots had from five to twenty percent new growth from the crown, the greater amounts occurring on the plots with the lighter applications. The amine plots appeared normal except for a very few dead stems on the two-pound plot. All plots were sprayed again June 15, 1949, repeating the 1948 procedure. In a month all treated plots were completely defoliated. After four months the one-pound amine plot had eight plants with clusters of six to eight small new leaves present. No other plots had regrowth present. Crowns and roots of all plants with dead tops that were examined on all plots appeared to be dead and decomposing. A few poison ivy plants were present in each of the plots described above. No treatment defoliated them in 1948, but no leaves remained on the plants from any treatment in 1949. (Contribution of Kansas Agricultural Experiment Station and McPherson County, Kansas, Noxious Weed Department.)

Effect of two 2,4-dichlorophenoxyacetic acid formulations sprayed on western snowberry (Symphoricarpus occidentalis), in pasture using 3 different rates. Leggett, H. W. The two formulations used were the triethanolamine and the butyl ester, and the rates used were 1, 1.5 and 2 pounds of 2,4-D acid per acre. The plots were sprayed on June 21 when the plants were in the full-leaf stage. The pasture was very dry as very little rain had fallen since April. Soaking rains did not fall until the middle of July, and up to that time none of the plots showed any effect from the spraying. One week after the rain, visible effects were noticeable, and by July 28 there were no leaves on any of the plots in any of the replications sprayed with the butyl ester. On the amine-treated plots, only the 2 pound application was 80 percent stripped of leaves, the other two rates merely showing a very small percentage of stripped leaves. Discoloration of the leaves was present in all the amine plots, but no further effect has been noted, and at the time of writing the leaves are still present. No regrowth from new crold shoots has been observed. Western snowberry sprayed in 1948 with 1.5 pounds acid per acre gave only 15 percent regrowth in 1949. (Contribution Dominion Experimental Farms, Lacombe, Alberta, Canada.)

The Effect of stage of development on the control of hawthorn (Crataegus sp.) with 2,4-D. Gammon, W. M., and Bibbey, R. O. Sodium and triethanolamine salts and the isopropyl ester of 2,4-D were applied as foliage sprays to hawthorn in 1948 at the following stages of development: (1) buds starting to open; (2) buds half open; (3) leaves half size; (4) leaves fully developed; (5) flowers in bud; and (6) full bloom. Concentrations of 1,000, 2,000, and 4,000 ppm were used. Treatments were made in triplicate and final notes taken August 22, 1949. No complete kill was obtained with any treatment applied at either of the first two stages of development. Variable results were obtained at the third and fourth dates, particularly with sodium salt at the lighter rates. All treatments gave satisfactory kills of both top growth and roots when applied at the flower-bud and full-bloom stages. In a number of cases, notes taken at the end of the first season differed markedly from those taken a year later, bushes that had green foliage in September 1948 failing to re-establish themselves in 1949. Apparently developing buds were affected by the spray. (Contribution of the Dept. of Botany, Ontario Agricultural College.)

Chemical brush control work by REA-financed power systems. REA-financed power systems have an enormous brush control problem. In July 1949, it was estimated that more than 200,000 miles of their electric line rights-of-way were covered with woody growth. The control of this growth constitutes a major part of line maintenance costs. During 1949, at least 48 REA-financed power systems utilized chemicals for the control of woody growth on rights-of-way. Although a few power systems applied a small quantity on a test basis, most of those reporting used chemicals on a larger scale. Reports have been received from 22 of these power systems to date. One power system used ammate, 21 used a combination of 2,4-D and 2,4,5-T esters, and one used 2,4-D alone for most of its chemical brush control work. Power system operators who had experience with chemical control prior to 1949, are convinced that the chemicals used this year were more effective than those used previously, but most are of the opinion that the herbicides now available will not effect complete control of all species. Over 3,600 miles and 700 acres of rights-of-way were reported by the 22 electric cooperatives as having been treated with foliage sprays, applied during the growing season. The use of a mileage unit or an acre unit depended on the distribution of woody plant growth, the former unit being desirable where growth was scattered or in a row, the latter in forested areas where it is necessary to clear a swath through more uniformly distributed brush. Comparing the above use of chemicals with that in 1948, REA records show that 13 cooperatives reported the use of chemicals in 1948, treating 320 miles and 400 acres of rights-of-way with foliage sprays. In 1948 six of the cooperatives obtained 2,4,5-T and seven used 2,4-D alone or ammate alone. Of the power system managers who have at this time reported the use of chemicals this year, most are convinced that chemical brush control affords the cheapest and most practicable method of control and intend to continue with the use of chemicals. Present labor costs make the cost of manual cutting higher than chemical control in most localities, except where cheap labor is available. The main disadvantage of mechanical or manual cutting is its failure to kill, a more dense regrowth occurring after each cutting. A few cooperatives, concerned with the apparent failure of present herbicides to effect one-hundred-percent kill of all species, are investigating the use of bulldozers for re-clearing. In North Carolina it was found that contract bulldozing could be done for $37 per acre, the cost comparing favorably with contract spraying when a 50-50 combination of 2,4-D and 2,4,5-T was used. (New Developments Section, Technical Standards Division, R.E.A., U. S. Department of Agriculture.)

Reaction of different woody species to 2,4-D and 2,4,5-T used alone or in various combinations and rates at the full foliage stage, 1949. Pavlychenko, Thomas K. In 1949, at Saskatoon, Sas., 32 woody or semi-woody perennial species have been treated at the foliage stage with Weedone Brush Killer 32 (Butoxy esters of 2,4-D and 2,4,5-T), ACP 572 (similar formulation), Weedone Concentrate 48 (ethyl ester of 2,4-D), and ACP 638 (acid of 2,4-D) at rates of 1, 2, and 3 lbs./a. and concentrations corresponding to 1,000, 2,000, and 3,000 ppm. Results: The readings were taken one month after treatments and just prior to the killing frost in the fall. (Reaction I) A complete top kill and no resprouting was recorded in chokecherry, pincherry, currants, hazelnut, honeysuckle, Juneberry, lilac, spiraea and narrow and broad-leaved willows with all the four chemicals and at all the three rates used. This reaction was obtained also with Weedone 32 and ACP 572 at 3,000 and often 2,000 ppm rates, on ash, bearberry, buckbrush, buffalo-berry, dogwood, hawthorn, maple (Manitoba), poplar (balsam), rosebush, and silverberry. Creeping juniper gave Reaction III to all the chemicals used; even at 3,000 ppm concentration. Rosebush gave Reaction IV consistently to all 2,4-D formulations but was very susceptible to mixtures of 2,4-D and 2,4,5-T even at 1,000 and 2,000 ppm concentrations. Most of the susceptible species were affected more or less in proportion to the rates used. Final readings on regrowth will be taken in 1950. (Contribution of Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Effect of various Systemic herbicides on Wild rose (Rosa pratincola) 1948, 1949. Pavlychenko, Thomas K. On July 23, 1948, one-rod square plots of wild roses were treated in triplicate with Weedone Standard (Ethyl Ester of 2,4-D), Weedone concentrate 48 (Ethyl Ester of 2,4-D), and LFN 549 (ester of 2,4,5-T) at rates of 8, 16, and 24 oz./acre on the light, sandy loam at Saskatoon, Sask. Original infestation was from 108 to 128 shoots per square yard. Results: On October 7, 1948, counts were made in one square yard quadrats in triplicate on all plots. At 8 oz./per acre Weedone Standard and Weedone Concentrate 48 have no observable effect neither on foliage nor on branches. LFN 549 at the same rate defoliated the plants 100 percent but stems remained green with the exception of small branches. At 16 oz./acre rates the esters of 2,4-D produced considerable discoloration on leaves but the woody parts remained green. At 16 oz./acre rate LFN 549 killed the foliage and most of the leaf-bearing branches were also dead. At 24 oz./acre rates Weedone Concentrate 48 and Weedone Standard destroyed the foliage wherever the contact was complete. The stems, however, remained alive until the freeze-up. Ester of 2,4,5-T at the same rate produced a complete defoliation, and the above-ground woody parts were dry. In October 1949 the number of plants was reduced by 80%, 93%, and 100% in the 8, 16, and 24 oz./acre rates of LFN 549, respectively, with no reduction in stand in the plots treated with Weedone Standard and Weedone Concentrate 48. (Contribution of the Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Response of woody species to herbicides. Coupland R. T. One hundred and sixteen plots of 7 woody species were treated in 1949 with butyl ester of 2,4-D and a mixture of 2,4-D and 2,4,5-T (Weedone Brush Killer No. 32) on loam soils in the dark-brown soil zone near Saskatoon. Treatment was done by wetting the foliage and bark thoroughly with concentrations of 2,000 and 4,000 ppm of acid in a solution of 1 gallon of diesel fuel to 3 gallons of water. Treatments on May 2 and 3, when the plants were in the early succulent growth stage, were less effective than those made on May 20 to 25, when the plants were in full leaf. Generally, the higher concentration was more effective than the lower one. 2,4-D alone was more effective on Populus tremuloides, and Symphoricarpos occidentalis, while the mixture was more effective on Elaeagnus commutata, Rosa, sp., Ribes sp., and Prunus melanocarpa. Salix spp. reacted about equally well to both herbicide treatments. Defoliation lasting throughout the season from the most effective herbicide averaged 50, 86, 78, 60, 51, 66, and 86 percent, respectively, on Populus, Symphoricarpos, Elaeagnus, Rosa, Ribes, Prunus, and Salix. Corresponding percentages of dead wood resulting were 30, 82, 4, 40, 36, 35, and 58. Although defoliation averaged 5 to 65 percent on Elaeagnus, Rosa, Ribes, and Prunus from 2,4-D alone, practically no killing of wood resulted. The plots will be examined in 1950 in order to evaluate the lasting effects of the treatments. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Field trials using 2,4-D, 2,4,5-T, and a combination of 2,4-D and 2,4,5-T applied during the dormant season for control of willows. Butler, C. C. Field trials to determine effectiveness of spraying willows during the dormant season were started in the fall of 1948. In field trials near Billings, Montana, treatments were applied to willows (Salix interior var. pedicillata (Andress)), five or six years old standing 4 to 5 feet high, and willows approximately 25 years old standing 12 to 15 feet high. Applications were made in November and April. Material used for the November application was 2,4-D only and for the April application 2,4-D, 2,4,5-T, and a combination of 1-1/3 pounds of 2,4-D acid plus 2/3 of a pound of 2,4,5-T acid. All materials were mixed with diesel oil at a concentration of 4,000 ppm and applied in amounts approximating 10 pounds of acid equivalent per acre. Mixtures were applied to standing willows, stubs cut 6 inches above the ground, willows with bark bruised on one side, and willows with bark bruised on two sides.

Observations during the 1949 growing season showed no regrowth on any canes or stubs regardless of the chemical used, size of willows or time of treatment. All plots showed some regrowth from lateral root stocks. November applications of 2,4-D produced slightly better root stocks control than April applications. Stub treatment gave slightly better control than on standing willows. 2,4-D gave better control than 2,4,5-T, and the combination of 2,4-D - 2,4,5-T was more effective than 2,4,5-T. Regrowth from lateral root stocks on standing willows was estimated to be 4 percent for 2,4-D applied in November, 10 percent for 2,4-D applied in April, 15 percent for the combination of 2,4-D - 2,4,5-T applied in April, and 30 percent for 2,4,5-T applied in April. Regrowth from lateral root stocks from cut stubs was estimated to be 3 percent for 2,4-D applied in November, 10 percent for 2,4-D applied in April, 25 percent for 2,4,5-T applied in April, and 30 percent for the combination 2,4-D - 2,4,5-T applied in April. Results were much less effective at other locations in Region 6 where the spray mixture used had an acid equivalent ranging from 2 to 5 pounds per acre. (Contributed by the U. S. Dept. of the Interior, Bur. of Reclamation, Region 6, Billings, Montana, cooperating with Montana State College, Bozeman, Montana.)

A study of the feasibility of using a helicopter for spraying willows on irrigation systems. Butler, C. C. A study to determine the feasibility of using a helicopter to spray willows on irrigation systems was initiated on the Milk River Project near Malta, Montana, during the summer of 1948. Spray mixtures were calculated on the basis of two pounds of 2,4-D acid per acre using from 2.5 to 28 gallons of solution per acre. Where the willows were relatively thin and not more than about 8 feet tall, little or no regrowth appeared regardless of the gallons of solution used. On other areas regrowth ranged up to 50 or 55 percent. The study was repeated during the summer of 1949 applying 2,4-D at rates of 2,4, and 8 pounds of acid per acre, 2,4,5-T,and 2,4-D / 2,4,5-T combined at 2, 4, and 6 pounds of acid per acre mixed with 5, 10, and 20 gallons of water per acre. The spray nozzles were calibrated prior to flying to produce drop sizes, the majority of which were in excess of 500 microns in diameter. Nozzles to produce this drop size with 40 pounds pressure were .116 of an inch in diameter. The relatively large drop size combined with the helicopter rotor down blast caused the spray to go almost straight down when the wind velocity did not exceed 10 to 12 miles per hour and the speed of the helicopter not more than 20 miles per hour. Observations at the end of the growing season indicated that the spray had been well controlled as there was very little evidence of drift, only traces of regrowth had appeared, and all treatments appeared to be equally effective regardless of chemical used or rate of application. Final results of the effects of the 1949 spraying will not be known until the summer of 1950. (Contributed by the U. S. Department of the Interior, Bureau of Reclamation, Region 6, Billings, Montana, in cooperation with Montana State College, Bozeman, Montana.)

Spraying Ribes by helicopter with 2,4-D and 2,4,5-T. Offord, H. R. and Moss, V. D. In August 1949, fourteen months after spraying Ribes and associated brush with 2,4-D by helicopter, a 10 percent sample of the 16 plots on the Sierra National Forest, California, showed: Most effective formulation, ester in diesel oil; intermediate, aqueous ammonium salt plus summer oil emulsion plus a sticker-spreader and aqueous ester plus a sticker-spreader; least effective, aqueous amine. On the plot treated with the isopropyl ester of 2,4-D in diesel oil (33.4 ounces acid in 5 gallons of oil per acre) 86 percent of the R. roezli and 96 percent of the R. nevadense were dead. Increased volume of spray compensated for decreased dosage of the 2,4-D. Ten gallons of oil (or the same volume of water containing 1-2% oil emulsion) and 1 1/2 pounds 2,4-D per acre seemed an effective and practical dosage for the initial spraying operation. Ribes kill varied greatly on different parts of a single plot where rough terrain, tall trees or snags had forced the helicopter to change the prescribed flight line and to fly 40 feet or more above the brush. On the

Cour d'Alene National Forest, Idaho, June 22-25, 1949, a Bell 47-D helicopter was used to spray R. lacustro, R. viscosissimum and associated brush with 2,4,5-T ester. Dosage rates of 1, 2, and 3 pounds of acid (2,4,5-T) in 5 and 10 gallons of diesel oil, and in water containing 1 percent summer oil emulsion, were used in treating 12 plots. Elevations of the plots varied between 4,000 and 4,600 feet. September inspection showed that the 2,4,5-T water-emulsive oil formulation appeared to be as toxic to Ribes and brush as the 2,4,5-T straight oil and was less injurious to conifers. Idaho and California tests clearly showed the importance of spraying alternate strips from opposing directions and allowing at least 10 percent overlap. (Contribution of the Division of Plant Disease Control, Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture, Berkeley, Calif.)

Killing Ribes with 2,4-D and 2,4,5-T. Offord, H. R., and Moss, V. D. Principal conclusions from the 1948-49 investigations on the chemical control of Ribes in the western states are: (1) 2,4,5-T is toxic to R. acerifolium, R. binominatum, R. inerme R. lacustre, R. laxiflorum, R. montiganum, R. setosum, and R. viscosissimum--species that could not be killed economically with 2,4-D. (2) With conventional high-volume equipment an aqueous 2,4,5-T spray is effective on the Ribes just named when it contains 3,000 ppm acid equivalent of the ester plus 10,000 ppm summer oil emulsion. (3) In sprayers equipped with atomizing nozzles for low-volume work, 2-3 percent of the 2,4,5-T ester either in diesel oil or in water containing 2-3 percent summer oil emulsion effectively kills those same Ribes. (4) For equivalent amounts of total acid, the combination of 2,4-D and 2,4,5-T in several different proportions is not as effective on the above Ribes as the straight 2,4,5-T. (5) For mid-summer work on R. roozli, 2,4-D sprays containing the sodium salt (500 ppm acid equivalent) plus 10,000 ppm light-medium summer oil emulsion plus 400 ppm sticker-spreader are superior to the 2,4-D esters or salts without the oil and sticker-spreader. (6) A satisfactory bush kill is obtained by spraying the basal stems (with or without scarification) of R. nevadense and R. cersum with diesel oil or weed-killer oil, containing 50,000 ppm acid equivalent of the ester of 2,4-D or 2,4,5-T. Plants approaching dormancy are killed as readily by the basal stem treatment as are those in active-growth stage. (7) In Idaho tests, power-mist blowers show promise for applying 2,4,5-T concentrate to Ribes and brush within 100 feet of roadways. (Contribution of the Div. of Plant Disease Control, Bureau of Entomology and Plant Quar., U. S. Dept. of Agriculture, Berkeley, Calif.)

Use of a mist sprayer in brush control. Hoffman, O. L., and Sylwester, E. P. Experimental plots were sprayed on a large, mixed brush infested area. Dates of spraying were May 18, June 20, July 12, and August 5. A 50-50 mixture of 2,4-D & 2,4,5-T ester was applied with a mist blower at the rate of approximately 1-1½ lbs. of active ingredient per acre. Main species involved were: buckbrush, wild grape, hackberry, hazel, mulberry, red haw, elm, dogwood, elderberry, prickly ash, wild blackberry, sumac, wild plum, poplar, Iowa crab, sandbar willow, black willow, 5-leaf ivy, poison ivy, box elder, and several species of oak and hickory. Preliminary observations disclosed that shingle oak, mulberry, and Iowa crab were quite resistant at all dates. Elm, bur oak, and white oak were defoliated at all dates Best total kill of all species was obtained by the May 18 spraying followed by August 5 respraying. Half and half mixtures of 2,4-D and 2,4,5-T gave uniformly better results than either chemical used alone at the same rate. However, buckbrush was injured most by 2,4-D only and best kill was obtained by two spraying (May 18 and resprayed August 5), and next best kill was by the May 18 spraying. Where oak and hickory were well covered by the mist-spray, good kills were secured. Where extremely dense vegetation existed, the penetrated distance was not great. Sumac was only injured by the May 18 application, but killed by all later applications. Box elder was readily defoliated, but some resprouting occurred from the tree bases. Black locust was found to be extremely sensitive, defoliation occurring 100 feet from where spraying was done. Best general brush control was obtained by

50-50 mixtures of 2,4-D and 2,4,5-T esters that were applied May 18 and again on August 5. Of special interest is the severe effect this mixture had on horse nettle when applied either June 20 or July 12. Only a small amount of spraying was done with a 50-50 mixture in oil. Stump resprout control and brush control obtained with this mixture were excellent. Final evaluation of all plots and species will be completed in the spring of 1950.

Effect of 2,4-D and 2,4,5-T on sphagnum mosses and evergreen Labrador tea plants. Roe, Eugene I. Small plots were sprayed near Ely, Minnesota, in early August 1949 to determine the effect of 2,4-D and 2,4,5-T on sphagnum mosses and the evergreen Labrador tea plants which are important competitors of black spruce seedlings in cutover swamps. One- and two percent solutions of Esteron 44 and Esteron 245 were used, both singly and in combination and applied with hand pumps at the rate of about 300 gallons per acre. Preliminary results indicate that the sphagnum mosses are easily killed by the lowest concentration of both herbicides. With Labrador tea, the best results (20 percent defoliation) were obtained from the two plus two percent combined solution. The common bog shrub, leatherleaf, showed much greater defoliation from this combination of the herbicides. (Contribution of Lake States Forest Experiment Station, Bureau of Forestry, U. S. Dept. of Agriculture, University Farm, St. Paul, Minnesota.)

TABLES SHOWING REACTIONS OF WOODY PLANTS TO 2,4-D, 2,4,5-T, AND COMBINATIONS OF THESE TWO CHEMICALS

There are four large tables showing reactions of woody plants included in this report as follows:

1. To 2,4-D.
2. To 2,4,5-T.
3. To combination of 2,4-D and 2,4,5-T.
4. Comprehensive report by Dr. Thomas K. Pavlychenko, Saskatoon, Canada.

NOTE: BE SURE TO FAMILIARIZE YOURSELF WITH THE FOLLOWING LEGEND BEFORE STUDYING THE RESULTS GIVEN IN THE TABLES:

1. TYPES OF TREATMENT: Foliage spray (FS), Cut Surfaces (CS), Cut surface frills (CSF), Cut surface cups (CSC), and Dormant spray (DS)

2. TYPES OF PHYSIOLOGICAL REACTIONS:

Reaction Type - I (hypersensitive) - Any plant that is killed in certain designated stages of growth by one application of a given chemical.

II (sensitive) - Any plant that in certain designated stages of growth reacts to a given chemical and may be killed by repeated applications.

III (semi-tolerant) - Any plant that in certain designated stages of growth reacts to a given chemical but is not killed by repeated applications.

IV (tolerant) - Any plant that in designated stages of growth shows negligible reaction to a given chemical.

REACTIONS OF WOODY PLANTS TO 2,4-D

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Alder	Alnus incana	Ester 2000 PPM	FS		I	II				Mich.	MWD
Apple, Amer. Crab	Pyrus coronaria	Esters 3000 PPM	FS	I	II	II	II	III		Pa.	FAA
Apple, common	Pyrus malus	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
Ash, green	Fraxinus pennsylvanica	Ester 4000 PPM	FS				IV			Neb.	DK & NS
Ash, white	Fraxinus americana	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
Barberry, European	Berberis vulgaris	Amine concen.	CS		II	II	II	II	II	Wash.	HBB
Barberry, Native Colorado	Berberis fendleri	I.Ester 2000 PPM	FS	I	II	II	II	II	II	Colo.	M&L
Basswood	Tilia americana	I.Ester 8000 PPM in Oil	D						III	Mich.	C&D
Birch	Betula papyrifera	I.Ester 2000 PPM	FS		II	II	II			Mich.	MWD
Birch, gray	Betula populifolia	I.Ester 1000 PPM	FS		II		II			Pa.	WEM
Blackberry	Rubus spp.	Ester 2000 PPM	FS		IV	IV	IV	IV		Ill.	EWS
		I.Ester 8000 PPM in Oil	D						III	Mich.	C&D
Blackberry, wild	Rubus allegheniensis	Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
Blueberry	Vaccinium angustifolium var.	Eth. & I.Ester 2000 PPM	FS		II		II			Pa.	WEM
Brier, common green	Smilax rotundifolia	Ester, 3000 PPM	FS	III	IV	IV	IV	IV		Pa.	FAA
		I.Ester, 8000 PPM in Oil	D						III	Mich.	C&D
Buckbrush	Symphoricarpos occidentalis	Ester, 1# per acre	FS			I				Man.	WJB
		Ester, 1½# per acre	FS			I				Man.	WJB
		Amine, 1#	FS			IV				Man.	WJB
		Amine, 1½#	FS			IV				Man.	WJB

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Buckbrush	Symphoricarpos occidentalis (cont)	E. 1 & 2 lbs./ acre	FS		II	II				Neb.	DK & NS
		I. Ester 1000 PPM	FS				III			Minn.	HLH
		I. Ester 2000 PPM	FS				III			Minn.	HLH
		I. Ester 4000 PPM	FS				III			Minn.	HLH
		Eth.Ester 1000 PPM	FS				III			Minn.	HLH
		Est. Amine ½ to 2 lbs.	FS			II				Sask.	HAF
		Eth.Ester 2000 PPM	FS				II			Minn.	HLH
		Eth.Ester 4000 PPM	FS				II			Minn.	HLH
Cactus, cholla	Opuntia imbricata	Ester oil	FS	II	III	III	IV	IV	IV	Tex.	F&Y
		Amine	FS	III	IV	IV	IV	IV	IV	Tex.	F&Y
Cedar, dryland	Juniperus pinchota	Ester Oil	FS				IV			Tex.	F&Y
		Amine	FS				IV			Tex.	F&Y
Cedar, salt	Tamarix gallica	Ester & NA salt 4 lbs. per acre	FS	I	II	II	III	II	III	A&N	BOR
		Ester 5%	CS	I	I	I	I	I	I	A&N	BOR
Cherry,choke	Prunus virginiana	I.Ester 2000 PPM	FS			II	II			Mich.	MWD
		I.Ester in oil 4000 PPM	D						II	Mich.	MWD
Cherry, wild	Prunus serotina	Esters, 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
		Ester, 2000 PPM	FS		II	II	II			Ill.	FWS
		I.Ester, 8000 PPM in Oil	D						III	Mich.	C&D
Chestnut	Castanea dentata	I.Ester 1000 PPM	FS		III		IV			Pa.	WEM
Chokeberry,	Aronia melanocarpc	Eth. & I.Esters 2000 PPM	FS		IV		IV			Pa.	WEM
Cottonwood	Populus deltoides	Esters,3000 PPM	FS	I	II	II	II	II		Pa.	FAA

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Currant, Alpine	Ribes montigenum	E&S 1000 ≠ PPM	FS/CS	III	IV	IV	IV	IV	IV	C Etal	HRO
Currant, Am. black	Ribes americanum	Salts & Esters 1000 PPM	FS	I	I	I	I	I		M&W	JKK
Currant, Hudson Bay	Ribes hudsonianum	Salts & Esters 1000 PPM	FS	I	I	I	I	I		M&W	JKK
Currant, prickly	Ribes lacustre	E&S 1000 ≠ PPM	FS/CS	III	IV	IV	IV	IV	IV	C Etal	HRO
Currant, red flower	Ribes sanguinem	E&S 750 PPM	FS/CS	I	II	II	III	III		C Etal	HRO
Currant, Sier. Nev.	Ribes nevadense	E&S 500≠PPM	FS/CS	I	I	I	II	II		C Etal	HRO
Currant, Squaw	Ribes cereum	E&S 1000 ≠ PPM	FS/CS	I	II	II	II	II		C Etal	HRO
Currant, stink	Ribes bracteosim	E&S 250 ≠ PPM	FS	I	I	I	II	II		C Etal	HRO
Currant, West.black	Ribes petiolare	E&S 250 ≠ PPM	FS/CS	I	I	I	II	II		C Etal	HRO
Currant, wild	Ribes oreophilus	Ester 2000 PPM									
Dewberry	Rubus vilosus	Esters,3000 PPM	FS	III	III	III	III	IV		Pa.	FAA
Dogwood	Cornus stolonifera	Various Esters 1-2# per acre	FS	I	II					Man.	HEW
Elderberry	Sambucus spp.	Ester,2000 PPM	FS	I	I	I	I			Ill.	FWS
Elder, box	Acer negundo	Various Esters 1-2# per acre	FS	I	I					Man.	HEW
		Esters,3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Elder, common	Sambucus canadensis	Esters 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Elm	Ulmus spp.	Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Elm, American	Ulmus Americana	I.Ester 8000 in oil	D						III	Mich.	C&D
		Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Elm, Red	Ulmus fulva	Ester 4000 PPM	FS				IV			Neb.	K&S
Fern, sweet	Myrica peregrina asplenifolia	Eth.1000 ≠ 2000 Iso. Ester	FS		I		I			Pa.	WEM
Gooseberry, gummy	Ribes lobbii	E&S 1000 ≠ PPM	FS/CS	II	II	II	III	III		C Etal	HRO
Goosebrry, Sier.Nev.	Ribes reezli	E&S 250 ≠ PPM	FS/CS	I	I	I	II	II	II	C Etal	HRO
Gooseberry,Siskiyou	Ribes binominatum	E&S 2000 ≠ PPM	FS	II	II	II	III	III		C Etal	HRO
Gooseberry, White St.	Ribes inerme	E&S 2000≠PPM	FS	II	II	II	III	III		C Etal	HRO
Grape, wild	Vitus vulpina	E. 2000 PPM	FS		II	II	II	II		Ill.	FWS

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ	Late Season: No Succ. Growth	Pre-dormant	Dormant	State	Authority
Gum, tupelo or Bl.	Nyssa sylvatica	Amm.Salt 4500 PPM	FS		II	II	I	II		SC	LEC
		I.Ester 50,000 in oil	CS						I	SC	LEC
Gum, sweet	Liquidambar styraciflua	Am.Salt 4500 PPM	FS		II	II	II	III		SC	LEC
		I.Ester,2200 PPM	FS					III		SC	LEC
		I.Ester,25,000 PPM	CS						III	SC	LEC
		I.Est. 1000,000 PPM in oil	CS						II	SC	LEC
		Meth.Ester,20,000 PPM	CSC			III				LA	USFS
		Meth.Ester,20,000 PPM	CS			II				LA	USFS
		Meth.Ester,40,000 PPM	CSC			III				LA	USFS
		Meth.Ester 40,000 PPM	FS			II				LA	USFS
Hackberry	Celtis occidentalis	Ester 4000 PPM	FS				IV			Neb.	K&S
Hawthorn	Crataegus spp.	Various Esters 1-2 lbs./acre	FS	I	II					Man.	HEW
		I.Ester, 2000 PPM	FS			III	III			Mich.	MWD
		I.Ester, 4000 PPM	FS			II	II			Mich.	MWD
		I.Ester,4000 PPM in Oil	D						II	Mich.	MWD
Hazel	Corylus cornuta	I.Ester, 4000 PPM	D						II	Mich.	MWD
		I.Ester, 2000 PPM	FS		I	I	I			Mich.	MWD
Hazel, brush	Corylus spp.	Var. Esters 1-2#/acre	FS	I	II					Man.	HEW
Hickory	Carya spp.	Meth.Ester,40,000 PPM	FS			II				La.	USFS
Hickory,Shellbark	Carya ovata	Esters, 3000 PPM	FS	II	III	III	III	III		Pa.	FAA
Ivy, Poison	Rhus radicans Rydbergii	Eth.Ester, 2250 PPM	FS				II			Minn.	HLH
		Eth.Ester,4500 PPM	FS				II			Minn.	HLH
		Eth.Ester, 9375 PPM	FS				II			Minn.	HLH
		Eth. Ester,18,750 PPM	FS				II			Minn.	HLH
Ivy, Poison	Rhus toxicodendron	Ester, 2000 PPM	FS		I	I	I			Ill.	FWS
		I.Ester, 2000 PPM	FS		II	II	II			Mich.	C&D
		Esters, 3000 PPM	FS	I	II	II	II	III		Pa.	FAA
Juneberry	Amelanchier alnifolia	I.Ester, 2000 PPM	FS			II	II			Mich.	MWD
		E&A, 1-4#/acre	FS		II	II				Colo.	USFS

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-Dormant	Dormant	State	Authority
Laurel, sheep	Kalmia angustifolia	Eth.&I.Ester Conc.	FS		II		II			Pa.	WEM
Locust, Black	Robinia pseudoacacia	Eth.E., 400 PPM	FS		II					Minn.	HLH
		Eth.E., 800 PPM	FS		I					Minn.	HLH
		Eth. E.1,600 PPM	FS		I					Minn.	HLH
		Ester, 3,000 PPM	FS	I	I	I	II	II		Pa.	FAA
Locust, Honey	Gleditsia triacanthos	Ester 2#/acre	FS		IV					Neb.	S&S
Lote	Condalia obtusifol.	Ester oil	FS	II	III	III	III	III	III	Tex.	F&Y
		Ester oil	CS		II	II	II	II	II	Tex.	F&Y
		Amine	FS	III	III	III	III	IV	IV	Tex.	F&Y
Mahonia	Mahonia repens	I.Ester, 2000 PPM	FS		IV	IV	IV			Colo.	L&M
Maple, Red	Acer rubrum	Esters, 3000 PPM	FS	III	IV	IV	IV	IV		Pa.	FAA
		I.Ester, 1000 PPM	FS		IV		IV			Pa.	WEM
		I.Ester, 2000 PPM	FS			III	III			Mich.	MWD
Maple, Sugar	Acer saccharum	I.Ester,8000 in oil	CS						II	Mich.	C&D
		I.Ester, 3000 PPM	FS		III		III			Mich.	C&D
Mesquite	Presopis juliflora glan.	2% Ester + oil	CS		I	I	I	I	I	Tex.	F&Y
		Amine 4#/gal.	CS		I	I	I	I	I	Tex.	F&Y
		Amine 2#/acre	FS	II	II	II	III	IV	IV	Tex.	F&Y
		Ester, 2#/acre	FS	II	II	II	III	IV	IV	Tex.	F&Y
Myrtle, Wax	Myrica cerifera	Amm.Salt, 4500 PPM	FS		II	II	II	II		SC	LEC
		I.Ester, 50,000 PPM in oil	CS						I	SC	LEC
Oak, Black Jack	Quercus marilandica	Am.Salt, 10,000 PPM	CSF		II	II	III	III	II	La.	USFS
		Am.Salt, 20,000 PPM	CSF		II	II	III	III	I	La.	USFS
		Am.Salt, 10,000 PPM	CS		II		III	III	III	La.	USFS
		Acid, 10,000 PPM	FS		II		III	IV		La.	USFS
		I.Ester, 20,000 PPM	CSF		II		II	II	II	La.	USFS
		I.Ester, 20,000 PPM	FS		II	II	II			La.	USFS
Oak, Bur	Quercus macrocarpa	Var. Esters, 2#/acre	FS	IV	IV					Man.	HEW

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season Growth Succ.	Mid-Season Growth Succ.	Mid-Season No Succ. Growth	Late Season Pre-dormant	Dormant	State	Authority
Oak, Laurel	Quercus imbricaria	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Oak, Post	Quercus stellata	Amm.Salt 4500 PPM	FS		II	II	II	II		SC	LEC
		I.Ester 50,000 PPM in Oil	FS						II	SC	LEC
Oak, Red	Quercus rubra	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	RAA
Oak, Scrub	Quercus gambelii	Ester 2000 PPM	FS		IV	IV	IV			Ill.	FWS
		Ester or Am. ½ lb.	FS			II				Colo.	USFS
Oak, Scrub	Quercus illicifolia	I.Ester 2000 PPM	FS		III		IV			Pa.	WEM
		Eth.Ester 2000 PPM	FS		III		IV			Pa.	WEM
Oak, White	Quercus alba	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Osage Orange	Maclura pomifera	Ester, 1000-2000, 4000 PPM	FS			IV				Neb.	K&S
		Ester 2000 PPM	FS		IV	IV	IV			Ill.	FWS
		Esters 3000 PPM	FS	IV	IV	IV	IV	IV		Pa.	FAA
Pear, Prickly	Opuntia sp.	Ester in Oil	FS	II	III	III	IV	IV	IV	Tex.	F&Y
		Ester in Oil	FS	III	IV	IV	IV	IV	IV	Tex.	F&Y
Pine, Eastern wh.	Pinus strobus	Eth.Ester 18,000 PPM	FS	I			III			Minn.	HLH
		Eth.Ester 9,000 PPM	FS	I			III			Minn.	HLH
		Eth.Ester 6000 PPM	FS	I			III			Minn.	HLH
Plum, Wild	Prunus americana	Ester 2000 PPM	FS				II			Neb.	K&S
Poplar, White (Aspen)	Populus tremuloides	Var. Esters 1 & 2 lbs./acre	FS	I	II					Man.	HEW
		I.Ester 4000 PPM	FS			II				Mich.	MWD
Rabbit Bush, small	Chrysothamnus stenophyllus	Ester or Am. ½#/acr.	FS			IV				Colo.	USES
Rose, Prairie	Rosa pratincola	½ to 3# E. Amine	FS			IV				Sask.	HAF
Rose, Wild	Rosa spp.	Var.Esters 1-2#/acre	FS	IV	IV					Man.	HEW
Sagebrush, Big	Artemissia tridentata	E & A 1-4#/acre	FS		II	II				Colo.	USFS
Sagebrush, Black	Artemissia nova	E&A Conc.1-4#/acre	FS		II	II				Colo.	USFS
Saltbush	Atriplex spp.	Ester or Na.3#/acre	FS	I	I	I	II			A&N	BOR

Common Name	Scientific Name	Formulations and Concentrations 2,4-D	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Growth	Late Season: Pre-dormant	Dormant	State	Authority
Sassafras	Sassafras albidum	I.Ester 1000 PPM	FS		II		II			Pa.	WEM
Saskatoon (See Juneberry)	Amelanchier alnifolia	Var. Esters 1-2# per acre	FS	I	II					Man.	HEW
Silverberry	Eleagans commutata	½-2# Ester-Amine	FS			II				Sask.	HAF
Spicebush	Benzoin aestivale	Esters 3000 PPM	FS	I	I	I	I	II		Pa.	FAA
Sumac, Staghorn	Rhus typhina	Esters 3000 PPM	FS	I	I	I	I	I		Pa.	FAA
Sycamore	Plantanus occidentalis	Esters 3000 PPM	FS	I	II	II	II	II		Pa.	FAA
Tobacco tree	Nicotiana glauca	Est. or Na Salt 2#	FS		I	I	II	II		A&N	BOR
Tree of Heaven	Ailanthus glandulosa	Esters 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Walnut, black	Juglans nigra	Esters 3000 PPM	FS	III	III	III	IV	IV		Pa.	FAA
Walnut, white	Juglans cinerea	Esters 3000 PPM	FS	I	II	II	III	III		Pa.	FAA
Willow	Salix spp.	Var. Esters 1-2# per acre	FS	I	I					Man.	HEW
		Ester 2000 PPM	FS		II	II	II			Ill.	FWS
Willow, Black	Salix nigra	Esters 3000 PPM	FS	I	I	I	II	II		Pa.	FAA
Xanthoxglum	Americanum	I.Ester 1000 PPM	FS				III			Minn.	HLH
		I.Ester 2000 PPM	FS				III			Minn.	HLH
		I.Ester 4000 PPM	FS				III			Minn.	HLH
		Eth.Ester 1000 "	FS				III			Minn.	HLH
		Eth.Ester 2000 "	FS				III			Minn.	HLH
		Eth.Ester 4000 "	FS				III			Minn.	HLH

REACTIONS OF WOODY PLANTS TO 2,4,5-T

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season Growth Succ.	Mid-Season Growth Succ.	Mid-Season No Succ. Growth	Late Season Pre-dormant	Dormant	State	Authority
Alder, speckled	Alnus incana	I.Ester 2000 PPM	FS		II	II	II			Mich.	MWD
Ash, Green	Fraxinus pennsylvanica		FS				IV			Neb.	K&S
Ash, Prickly	Xanthoxylum Americanum	I.Ester 1000 PPM	FS				III			Minn.	[illegible]
		I.Ester 2000 PPM	FS				III			Minn.	[illegible]
		I.Ester 4000 PPM	FS				III			Minn.	[illegible]
Ash, White	Fraxinus americana	Ester 1500 PPM	FS	III	III	III	III	IV		Pa.	FAA
Birch	Betula papyrifera	I.Ester 2000 PPM	FS		II	II	II			Mich.	MWD
Blackberry	Rubus sp.	Ester 2000 PPM	FS		I	I	I	I		Ill.	FWS
Blackberry	Rubus spp.	I.Ester 8000 in Oil	D						I	Mich.	C&D
Blackberry, wild	Rubus allegheniensis	Esters, 1500	FS	I	II	I	II	II		Pa.	FAA
Brier, green	Smilax rotundifolia	I.Ester 8000 in Oil	D						II	Mich.	C&D
Buckbrush	Symphoricarpos occidentalis				IV	IV				Neb.	K&S
		I.Ester 1000 PPM	FS				IV			Minn.	HLH
		I.Ester 2000 PPM	FS				IV			Minn.	HLH
		I.Ester 4000 PPM	FS				IV			Minn.	HLH
		1 lb.	FS		IV					Man.	WJB
		1½ lb.	FS		IV					Man.	WJB
Cactus, Cholla	Opuntia imbricata	5% Ester in Oil	FS	I	II	II	II	II	II	Tex.	F&Y
Cedar, Dryland	Juniperus pinchota	1% Ester in Oil	FS			IV				Tex.	F&Y
Cedar, salt	Tamarix gallica	I.Ester 4 lbs.	FS	I	II	II				A&N	BOR
Cherry, Choke	Prunus virginiana	Ester,1000,4000 PPM	FS				IV			Neb.	K&S
		I.Ester 4000 PPM	FS			I	I			Mich.	MWD
Cherry, Wild	Prunus serotina	Esters 1500 PPM	FS	I	I	I	I	II		Pa.	FAA
		I.Ester 8000 In Oil	D						II	Mich.	C&D
Currant, Am. Black	Ribes americanum	Ester 1000 PPM	FS	I	I	I	I	I		M&W	JKK
		Ester in Oil 24,000	BS		I	I	I	I		M&W	JKK
Currant,Crater Lk.	R. erythrocarpum	Amine 2000 PPM	FS			II				C&O	HRO
		Acid 1000 & 5000 PPM in tributyl phos. & kerosene	FS			II				C&O	HRO

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Growth	Late Season: Pre-dormant	Dormant	State	Authority
Currant, Hudson Bay	Ribes hudsonianum	Ester, 1,000 PPM	FS	I	I	I	I	I		M&W	JKK
Currant, Prickly	Ribes lacustre	Ester, 2,000 PPM	FS/CS	I	I	I	I	I		IMW	VDM
Currant, red flowering	R. sanguineum	Amine 2,000 PPM	FS			II	III			C&O	HRO
Currant, Sierra Nev.	R. nevadense	Am. 250-2000 PPM	FS		I	I	III			C&O	HRO
Currant, skunk	Ribes glandulosum	Ester 6,000 PPM	FS	II	II	III	III	IV		M&W	JKK
Currant, Squaw	Ribes cereum	Est. 2000-4000 PPM	FS	I	II	II	III			C&O	HRO
Currant, sticky	Ribes viscosissimum	Ester 2000 PPM	FS/CS	I	I	I	I	I		IMW	VDM
Currant, Swamp Red	R. triste	Esters 6000 PPM	FS	II	II	III	IV	IV		M&W	JKK
Currant	R. tularense	Est., 1000, 2000, 4000 PPM	FS			II	III	III		C&O	HRO
Currant, West Bl.	Ribes peticlare	Est. 2000 PPM	FS	I	I	I	I	I		IMW	VDM
Elderberry	Sambucus canadensis	I.Ester 2000 PPM	FS			II				Mich.	MWD
Elm, American	Ulmus americana	Ester 1500 PPM	FS	I	I	I	II	II		Pa.	FAA
Elm, Red	Ulmus fulva		FS				IV			Neb.	K&S
Gooseberry, Gummy	Ribes lobbii	Sod.125-2000 PPM	FS			II	III			C&O	HRO
		Am. 1000-2000 PPM	FS	I		I	II			C&O	HRO
Gooseberry, Mo.	Ribes Missouriensa	Esters 6000 PPM	FS	I	II	II	III	III		M&W	JKK
		Esters in Oil 24,000	BS		I	I	II	II		M&W	JKK
Gooseberry, prickly	Ribes cynosbati	Esters, 6000 PPM	FS	I	II	II	III	III		M&W	JKK
		Es.in Oil,24,000	BS		I	I	II	II		M&W	JKK
Gooseberry, Sier.Nev.	Ribes roezli	Sod.250-2000 PPM	FS			II	III			C&O	HRO
Gooseberry, Siskiyou	Ribes binominatum	Sod. 2,000 PPM	FS	I	I	II				C&O	HRO
		Am.1,000 PPM & Amm.	FS			I				C&O	HRO
		Sod.1,000 & S.Ch.Ph.	FS			I				C&O	HRO
Gooseberry, smooth	Ribes hirtellum	Esters, 6,000 PPM	FS	I	II	II	III	III		M&W	JKK
Gooseberry, White stemmed	R. inerme	Est. 2,000 PPM	FS	I	I	I	I	I		IMW	VDM
Gum, black	Nyssa sylvatica	I.Ester 25,000 PPM in Oil	CS						I	SC	LEC
Gum, sweet	Liquidampar styraciflua	I.Ester, 2200 PPM	FS			I	I	I		SC	LEC

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth	Mid-Season: Growth	Mid-Season: No Succ. Growth	Late Season: Succ.	Late Season: Pre-dormant	Dormant	State	Authority
Gum, Sweet (cont)	Liquidampar styraciflua	I.Ester, 2200 PPM	CS							I	SC	LEC
		I.Ester, 200,000 PPM in Oil	D							I	SC	LEC
Hackberry	Celtic occidentalis		FS				IV				Neb.	K&S
Hawthorn	Crataegus spp.	Esters 1500 PPM	FS	II	II	II	III	III			Pa.	FAA
		I.Ester 4,000 PPM	FS		II	II					Mich.	MWD
		I.Ester 2,000 PPM	FS			III	III				Mich.	MWD
Hazel	Corylus cornuta	I.Ester 2,000 PPM	FS			II	II				Mich.	MWD
Hazelnut	Corylus americana	I.Ester 8,000 in Oil	D							II	Mich.	O&D
Hickory ,	Hicoria ovata	I.Ester 8,000 in Oil	D							I	Mich.	C&D
Ivy, Poison	Rhus toxicodendron	Esters 1500 PPM	FS	I	I	I	I	II			Pa.	FAA
		Ester 1,000 PPM	FS		I	I	I				Ill.	FWS
		Ester 2,000 PPM	FS		I	I	I				Ill.	FWS
		I.Ester 2,000 PPM	FS		I	II	I				Mich.	C&D
Juneberry	Amelanchier alnifolia	1 qt. to 1 gal/acre	FS		II	II					Colo.	USFS
Locust, Black	Robinea pseudoacacia	Ester 800 PPM	FS		I						Minn.	HLH
		Ester 1500 PPM	FS	I	I	I	II	II			Pa.	FAA
Locust, Honey	Gleditzia triacanthos		FS				II				Neb..	K&S
Lote	Condalia obtusifolia	5% Ester Oil	FS	I	II	II	II	II	II		Tex.	F&Y
		1% Ester Oil	CS	I	I	I	I	I	I		Tex.	F&Y
Maple, Red	Acer rubrum	I.Ester 2,000 PPM	FS			II					Mich,	MWD
Maple, Sugar	Acer saccharum	Esters 1500 PPM	FS	III	III	III	III	IV			Pa.	FAA
		I.Ester 2,000 PPM	FS			III					Mich.	MWD
		I.Ester 8,000 in Oil	D							II	Mich.	G&D
		I.Ester 3,000 [illegible]	FS		II		II				Mich.	C&D
Mesquite	Prosopis juliflora	1% Ester Oil	CS		I	I	I	I	I		Tex.	F&Y
		2/3# Ester, 5 gal.oil emul./acre	FS	I	II	II	III	III	III		Tex.	F&Y
		1# Ester-20 gal.oil/acre	FS					II	II		Tex.	F&Y
Myrtle, Wax	Myrica cerifera	I.Ester-25,000 PPM in Oil	CS							I	SC	LEC

Common Name	Scientific Name	Formulations and Concentrations 2,4,5-T	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Oak, Black Jack	Quercus marilandica	20,000 PPM	CSF		II		II	II	II	La.	USFS
		20,000 PPM	FS		II		II			La.	USFS
Oak, Post	Quercus stellata	I.Ester 25,000 PPM in Oil	CS						I	SC	LEC
Oak, Scrub	Overcus gambelii	1-2 pts./acre	FS			II				Colo.	USFS
Oak, Water	Quercus nigra	I.Ester 200,000 PPM in Oil	D						I	SC	LEC
Oak, White	Quercus alba	Esters 1500 PPM	FS	I	I	I	II	II		Pa.	FAA
Osage orange	Maclura pomifera	1000,2000,4000 PPM Ester	FS		II	II				Neb.	K&S
Ozier, Red	Cornus stolonifera	I.Ester 4,000 PPM	FS			II	II			Mich.	MWD
Pear, Prickly	Opuntia sp.	1% Amine 80% oil	FS	I	II	II	II			Tex.	F&Y
Rabbit brush,small	Chrysothamnus sp.	1-2 pts./acre	FS			IV				Colo.	USFS
Rose	Rosa spp.		FS			II				Neb.	K&S
Rose, Prairie	Rosa arkansana	½-2#	FS			II				Sask.	HAF
Sagebrush, big	Artemissia tridentata	1 qt.-1 gal./acre	FS		II	II				Colo.	USFS
Sagebrush, black	Artemissia nova	1 qt-1 gal./acre	FS		II	II				Colo.	USFS
Willow	Salix spp.	I.Ester 2000 PPM	FS			I	I			Mich.	MWD

REACTIONS OF WOODY PLANTS TO 2,4-D AND 2,4,5-T COMBINED

Common Name	Scientific Name	Formulations and Concentrations 2,4-D and 2,4,5-T Combined	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings: Succ.	Early Season Growth: Succ.	Mid-Season Growth: No Succ.	Late Season Growth	Dormant: Pre-dormant	State	Authority
Alder	Alnus incana	I.Ester 8,000 PPM	FS			I	I		Mich.	MWD
		I.Ester 8,000 in Oil	CS				I		Mich.	MWD
Ash, green	Fraxinus pennsylvanica	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II		Tenn.	TVA
Ash, prickly	Zanthoxylum americanum	I.Ester 1,000 PPM	FS				III		Minn.	HH
		I.Ester 2,000 PPM	FS				III		Minn.	HH
		I.Ester 4,000 PPM	FS				III		Minn.	HH
Basswood	Tilia spp.	I.Ester 6,000 PPM	FS		IV	IV	IV		Ala.	TVA
		I.Ester 4,000 PPM	FS			IV	IV		Tenn.	TVA
Birch, Black	Betula lenta	3,000 PPM	FS	III	III	III	III		Pa.	FAA
Birch, River	Betula nigra	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I		Tenn.	TVA
Blackberry, Wild	Rubus spp.	Esters 1,000 PPM	FS	I	I	I	I		Ill.	FWS
		I.Ester 6,000 PPM	FS	I	I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I		Tenn.	TVA
Brier, Green	Smilax spp.	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II		Tenn.	TVA
Buckbrush	Symphoricarpos occidentalis	I.Ester 1,000 PPM	FS				IV		Minn.	HLH
		I.Ester 2,000 PPM	FS				II		Minn.	HLH
		I.Ester 4,000 PPM	FS				II		Minn.	HLH
		3/4-D/3/4-T Est.Am.	FS		II				Man.	WJB
		1/2-D/1/2-T Est.Am.	FS		II				Man.	WJB
Buckbrush	Symphoricarpos orbiculatus	I.Ester 6,000 PPM	FS	I	I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			II	II		Tenn.	TVA
Buckeye, Red	Aesculus pavia	I.Ester 6,000 PPM	FS		II	II	II		Ala.	TVA
		I.Ester 4,000 PPM	FS			II	II		Tenn.	TVA
Cane	Arundinaria spp.	I.Ester 6,000 PPM	FS	I	II	II	II		Ala.	TVA
Catalpa	Catalpa bignenoides	I.Ester 6,000 PPM	FS		I	I			Ala.	Tva

Common Name	Scientific Name	Formulations and Concentrations 2,4-D and 2,4,5-T Combined	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Cedar, Red	Juniperus virginiana	I.Ester 6,000 PPM	FS	II	II	II	II			Ala.	TVA
		I.Ester 4,000 PPM	FS			IV	IV			Tenn..	TVA
Cedar, Salt	Tamarix gallica	I.Ester 4# A.	FS	I	II	II				A&N	BOR
Cherry, Choke	Prunus virginia	I.Ester 8,000 PPM	FS			I	I			Mich.	MWD
Cherry, Pin	Prunus pennsylvanica	I.Ester 8,000 PPM	FS			I	I			Mich.	MWD
Cherry, Sweet	Prunus avium	3,000 PPM	FS	I	I	I	I			Pa.	FAA
Cherry, Wild	Prunus serotina	Ester 1,000 PPM	FS	I	I	I				Ill.	FWS
		I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Cottonwood	Populus deltoides	Esters 1,000 PPM	FS		II	II	II			Ill.	FWS
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Cucumber Tree	Magnolia acuminata	3,000 PPM	FS	I	II	II	II			Pa.	FAA
Currant, Am. Black	Ribes americanum	Esters 1,000 PPM	FS	I	I	I	I	I		MW	JKK
Currant, Hudson Bay	Ribes hudsonianum	Esters, ea.1,000 PPM	FS	I	I	I	I	I		M&W	JKK
Currant, Sierra Nev.	Ribes nevadense	Esters ,ea. 1,000 "	FS		I	I				C&O	HRO
Currant, skunk	Ribes glandulosum	Esters ea.,6000 PPM	FS	II	II	III	III	IV		M&W	JKK
Currant, squaw	Ribes cereum	Esters 1,000 PPM ea.	FS			I	II			C&O	HRO
Currant, Swamp Red	Ribes triste	Esters 6,000 PPM ea.	FS	II	II	III	IV	IV		M&W	JKK
Dogwood, flowering	Cornus florida	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			II	II			Tenn.	TVA
Elderberry	Sambucus canadensis	I.Ester 8,000 PPM	FS			II	II			Mich.	MWD
		I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Elderberry	Sambucus spp.	Esters 1,000 PPM	FS	I	I	I	I			Ill.	FWS
Elm, American	Ulnus americana	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Elm, slippery	Ulmus fulua	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Elm, winged	Ulmus alata	I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Gooseberry, Missouri	Ribes missouriense	Esters ea. 6,000 "	FS	I	II	II	III	III		M&W	JKK
Gooseberry, Prikcly	Ribes cynobati	Esters ea. 6,000 PPM	FS	I	II	II	III	III		M&W	JKK
Gooseverry, Sier.Nev.	Ribes roezlii	Esters 1,000 PPM ea.	FS	I	I	II	II			C&O	HRO

Common Name	Scientific Name	Formulations and Concentrations 2,4-D and 2,4,5-T Combined	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Late Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Gooseberry, Smooth	Ribes hirtellum	Esters ea. 6,000 PPM	FS	I	II	II	III	III		M&W	JKK
Grape, Wild	Vitus vulpina	Esters 1,000 PPM	FS	I	I	I	I			Ill.	FWS
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Gum, Black	Nyssa sylvatica	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
		3,000 PPM	FS	II	II	II	III			Pa.	FAA
Gum, Red	Liquidambar styraciflua	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II			Tenn.	TVA
Hawthorn	Crataegus spp.	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
		I.Ester 8,000 in Oil	CS				I			Mich.	MWD
Hazel	Corylus cornuta	I.Ester 8,000 PPM	FS			II	II			Mich.	MWD
Hickory	Hicoria spp.	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Honeysuckle	Lonicera japonica	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
Hydrangea, wild	Hydrangea arborescens	3,000 PPM	FS	I	I	II	II			Pa.	FAA
Ivy, Poison	Rhus toxicadendron	Esters 1,000 PPM ea.	FS	I	I	I	I			Ill.	FWS
		Esters 1,500-D,500-T	FS	I	I	I	I			Ill.	FWS
		I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Juneberry	Amelanchier alnifolia	1 qt.-1 gal./acre	FS		II	II				Colo.	USFS
Kudzu	Puerania thunbergiana	I.Ester 6,000 PPM	FS			I	I			Ala.	TVA
Locust, Black	Robinia pseudoacacia	I.Ester 4,000 PPM	FS		II					Ala.	TVA.
		I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II			Tenn.	TVA
Locust, Honey	Gleditsia triacanthos	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
Maple, Mountain	Acer spicotum	I.Ester 8,000 in Oil	CS				I			Mich.	MWD
Maple, Red	Acer rubrum	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II			Tenn.	TVA
		I.Ester, 8,000 in oil	CS				I			Mich.	MWD
Maple, silver	Acer saccharinum	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA

Common Name	Scientific Name	Formulations and Concentrations 2,4-D and 2,4,5-T Combined	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth	Late Season: Pre-dormant	Dormant	State	Authority
Mesquite	Prosopis juliflora	2 pt.2,4-D;1 pt -T Butoxyethanol Ester	FS	I	I	II	II	II	III	Tex.	F&Y
		1 pt 2,4-D; 1 pt -T activ.alkyl.ester	FS	I	I	II	II	II	III	Tex.	FY
		1 pt 2,4-D; 1 pt -T Iso. Ester	FS	I	II	III	III	III	III	Tex.	F&Y
Mulberry, Red	Morus rubra	I.Ester 6,000 PPM	FS		II	II	II			Ala.	TVA
Oak, Black Jack	Quercus marilandica	10,000 PPM -T; 20,000 PPM -D	CSF		II					La.	USFS
		10,000 PPM -T 20,000 PPM -D	FS		II					La.	USFS
		I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
Oak, Chestnut	Quercus montana	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Oak, Northern Red	Quercus Borealis	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	II			Tenn.	TVA
Oak, Post	Quercus stellata	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Oak, Scarlet	Quercus coccinea	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Oak, Scrub	Quercus gambelli	Esters 1,000 PPM	FS		III	III				Ill.	FWS
Oak, White	Quercus alba	I.Ester 6,000 PPM	FS		I	I	I			Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I			Tenn.	TVA
Osage Orange	Maclura pomifera		FS			II				Neb.	K&S
		Esters 1,000 PPM	FS		II	II				Ill.	FWS
Persimmon	Diospyros virginiana	Esters 1,000 PPM	FS	II	II	II				Ill.	FWS
		I.Ester 6,000 PPM	FS		II	II	III			Ala.	TVA
		I.Ester 4,000 PPM	FS			III	III			Tenn.	TVA
Pine, short-leaf	Pinus echinata	I.Ester 6,000 PPM	FS	I	I	I	I			Ala.	TVA
		I.Ester 6,000 PPM	FS		II	II	II			Ala.	TVA
		I.Ester 4,000 PPM	FS			II	II			Tenn.	TVA
		I.Ester 4,000 PPM	FS			III	III			Tenn.	TVA

Common Name	Scientific Name	Formulations and Concentrations 2,4-D and 2,4,5-T Combined	Type of Treatment	Type of Reaction According to Season and State of Growth: Young Seedlings	Early Season: Growth Succ.	Mid-Season: Growth Succ.	Late Season: No Succ. Growth	Dormant: Pre-dormant	State	Authority
Pine, Virginia	Pinus virginiana	I.Ester 6,000 PPM	FS	I	I		II		Ala.	TVA
		I.Ester 4,000 PPM	FS			III	III		Tenn.	TVA
Plum, Wild	Prunus spp.	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
Poplar, Yellow	(See Cottonwood)									
Poplar, Yellow	Liviodendron tulipifera	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
Redbud	Cercis canadensis	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			II	II		Tenn.	TVA
Sagebrush, Big	Artemissia tridentata	1 qt.-gal/acre	FS		II	II			Colo.	USFS
Sagebrush, Black	Artemissia nova	1 qt.-gal./acre	FS		II	II			Colo.	USFS
Sassafras	Sassafras varifolium	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I		Tenn.	TVA
Sumac, dwarf	Rhus glabra	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
Sumac, Fragrant	Rhus canadensis	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
Sycamore	Platanus occidentalis	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I		Tenn.	TVA
Willow	Salix, spp.	Esters 1,000 PPM	FS	I	I	I	II		Ill.	FWS
Willow, Black	Salianigra	I.Ester 6,000 PPM	FS		I	I	I		Ala.	TVA
		I.Ester 4,000 PPM	FS			I	I		Tenn.	TVA
Witch-Hazel	Hamamelis virginiana	3,000 PPM	FS	I	II	II	II		Pa.	FAA

Reaction of different woody species to 2,4-D and 2,4,5-T used alone or in various combinations and rates at the full foliage stage, 1949.

Thomas K. Pavlychenko
(Contribution of Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Common Name	Scientific Name	Formulations and Concentrations	Type of Treatment	Type of Reaction According to Season and stage of Growth — Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth
Ash, green	Fraxinus campestris	2000 ppm. WBK 32: 2:1;2,4-D:2,4,5-T	FS	II	-
" "	" "	3000 ppm. Ethyl ester	FS	I	-
" "	" "	3000 ppm. ACP 572 2:1, 2,4-D:2,4,5-T	FS	I	-
" "	" "	2000 ppm.,2,4-D acid	FS	II	-
Bearberry	Arctostaphylos Uva-ursi	3000 ppm.,Ethyl ester	FS	I	-
"	" "	3000 ppm., ACP 572 2:1, 2,4-D:2,4,5-T	FS	I	-
"	" "	3000 ppm., 2,4-D acid	FS	I	-
Birch, river	Betula fontinalis	2000 ppm., WBK 32: 2:1, 2,4-D: 2,4,5-T	FS	-	II
" "	" "	2000 ppm,Ethyl ester	FS	-	II
" "	" "	2000 ppm., ACP 572 2:1; 2,4-D: 2,4,5-T	FS	-	II
" "	" "	2000 ppm., 2,4-D acid	FS	-	II
Buckbrush	Symphoricarpos occidentalis	2000 ppm. WBK 32: 2:1, 2,4-D: 2,4,5-T	FS	I	-
"	"	3000 ppm. Ethyl ester	FS	-	I
"	"	3000 ppm., ACP 572 2,4-D, 2,4,5-T	FS	-	I
"	"	3000 ppm.,2,4-D acid	FS	-	II
Buffalo-berry	Shepherdia canadensis	3000 ppm, ACP 572 2,4-D, 2,4,5-T; 2:1	FS	I	-
" " thorny	Shepherdia argentea	2000 ppm, Ethyl ester	FS	-	I
" " "	" "	3000 ppm, 2,4-D acid	FS	-	I
Cactus, prickly-pear	Opuntia plyacantha	3000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	II
" " "	" "	2000 ppm. Ethyl ester	FS	-	III
" " "	" "	3000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	II
Caragana	Caragana arborescens	3000 ppm. WBK 32: 2:1, 2,4-D:2,4,5-T	FS	-	II
"	" "	2000 ppm. Ethyl ester	FS	-	III
"	" "	2000 ppm.,2,4-D acid	FS	-	III
"	" "	3000 ppm.	FS	-	II
Cherry, choke	Prunus melanocarpa	2000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
" "	" "	2000 ppm. Ethyl ester	FS	-	I

Common Name	Scientific Name	Formulations and Concentrations	Type of Treatment	Type of Reaction According to Season and Stage of Growth: Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth
Cherry, choke (cont)	Prunus melanocarpa	2000 ppm. ACP 572 2,4-D,2,4,5-T;2:1	FS	-	I
" "	" "	2000 ppm. 2,4-D acid	FS	-	I
Cherry, pin	Prunus pennsylvanica	1000 ppm, Ethyl ester	FS	-	I
" "	"	1000 ppm. ACP 572 2,4-D, 2,4,5-T	FS	-	I
" "	" "	1000 ppm. 2,4-D acid	FS	-	I
Currant, black	Ribes americanum	2000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
" "	" "	2000 ppm. 2,4-D acid	FS	-	I
Dogwood	Cornus stolonifera	3000 ppm. WBK 32 2:1; 2,4-D:2,4,5-T	FS	-	I
"	" "	3000 ppm. Ethyl ester	FS	-	I
"	" "	2000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	" "	3000 ppm. 2,4-D acid	FS	-	III
Gooseberry	Grossularia oxyacantloides	2000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	II
"	"	3000 ppm. Ethyl ester	FS	-	II
"	"	2000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	II
"	"	3000 ppm, 2,4-D acid	FS	-	II
Hawthorn	Crataegus succulenta	2000 ppm WBK 32: 2:1, 2,4-D:2,4,5-T	FS	-	II
"	" "	2000 ppm. Ethyl ester	FS	-	II
"	" "	2000 ppm. ACP 572 2,4-D, 2,4,5-T: 2:1	FS	-	II
"	" "	3000 ppm. 2,4-D acid	FS	-	III
Hazelnut	Corylus rostrola	1000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	" "	1000 ppm. 2,4-D acid	FS	-	I
Honeysuckle	Lonicer tartarica	2000 ppm. Ethyl ester	FS	-	I
"	"	2000 ppm. ACP 572 2,4-D, 2,4,5-T	FS	-	I
Ivy, Poison	Rhus toxicodendron	1000-2000 ppm. Eth.Ester	FS	I	-
" "		2000-3000 ppm. 2,4-D Acd.	FS	I	-
Juniper, creeping	Juniperus horizontalis	3000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	III
" "	" "	3000 ppm. Ethyl ester	FS	-	III
" "	" "	3000 ppm. 2,4-D acid	FS	-	III
Juniper, low	Juniperus communis	3000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	III
" "	"	3000 ppm. 2,4-D acid	FS	-	III
Juneberry	Amelanchier alnifolia	2000 ppm. Ethyl ester	FS	-	I
"		2000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	"	2000 ppm. 2,4-D acid	FS	-	I
Lilac	Syringia vulg.	2000 ppm. Ethyl ester	FS	-	I

Common Name	Scientific Name	Formulations and Concentrations	Type of Treatment	Type of Reaction According to Season and Stage of Growth: Mid-Season: Growth Succ.	Mid-Season: No Succ. Growth
Maple, Manitoba	Acer negundo	3000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
" "	" "	3000 ppm WC 48 Ethyl ester	FS	-	I
" "	" "	2000 ppm ACP 572 2,4-D, 2,4,5-T	FS	-	I
" "	" "	3000 ppm ACP 638 2,4-D acid	FS	-	I
Nettle, stinging	Urtica gracilis	1000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	II
Poplar, aspen	Populus tremuloides	3000 ppm. WC 48 Ethyl ester	FS	II	-
" "	" "	3000 ppm. ACP 572 2,4-D, 2,4,5-T;2:1	FS	-	III
" "	" "	3000 ppm. ACP 638 2,4-D acid	FS	II	-
Poplar, balsam	Populus balsamifera	2000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
Poplar, Russian	Populus Petroffskiana	2000 ppm WC 48 Ethyl ester	FS	I	-
" "	" "	2000 ppm ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	II
" "	" "	3000 ppm ACP 638 2,4-D acid	FS	-	II
Rosebush	Rosa sp.	2000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
"	" "	3000 ppm WC 48 Ethyl ester	FS	-	III
"	" "	2000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	" "	3000 ppm ACP 638 2,4-D acid	FS	-	IV
Silverberry	Elaeagnus argentea	2000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
"	" "	3000 ppm. WC 48 Ethyl ester	FS	-	I
"	" "	1000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	" "	2000 ppm. ACP 638 2,4-D acid	FS	-	IV
Spiraea	Spiraea alba	1000 ppm. WBK 32 2:1, 2,4-D:2,4,5-T	FS	-	I
"	" "	1000 ppm. WC 48, Eth. Es.	FS	-	I
"	" "	1000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	-	I
"	" "	1000 ppm. 2,4-D acid	FS	-	I
Willow	Salix petioloris	1000 ppm. Ethyl ester	FS	I	-

Common Name	Scientific Name	Formulations and Concentrations	Type of Treatment	Type of Reaction according to Season and Stage of Growth	
				Mid-Season	
				Growth Succ.	No Succ. Growth
Willow (cont)	Salix petioloris	1000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	I	-
"	" "	1000 ppm. 2,4-D acid	FS	I	-
"	Salix Bebbiana	1000 ppm, Ethyl ester	FS	I	-
"	" "	1000 ppm. ACP 572 2,4-D, 2,4,5-T; 2:1	FS	I	-
"	" "	1000 ppm, 2,4-D acid	FS	I	-

Reaction of different woody species to 2,4-D and 2,4,5-T used alone or in various combinations and rates at the full foliage stage, 1949

(Thomas K. Pavlychenko. Contribution of Agr. Div., American Chemical Paint Co.,Saskatoon, Sask.)

Species	TYPE OF REACTION TO: Brush Killer 32			Weedone Conc. 48			A.C.P. 572			A.C.P. 638		
	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.
Ash, green Fraxinus campestris	II	II	I	III	II	I	II	II	I	II	II	II
Bearberry Arctostaphylos Uva-ursi				III	III	II	III	II	I	III	III	II
Birch, river Betula fontinalis		II		II	II		II	I		III	II	II
Buckbrush Symphoricarpos occidentalis	I	I	I	II	II	I	II	II	I	III	II	II
Buffalo-berry, low Shepherdia canadensis							III	II	I			
Buffalo-berry, thorny Shepherdia argentea				I	I	I				II	I	I
Cactus, prickly-pear Opuntia polyacantha	III	III	II	III	III	III	III	III	II			
Caragana Caragana aborescens	III	II	II	III	III	III	III	III	II	III	III	III
Cherry, choke Prunus melanocarpa	II	I	I	I	I	I	I	I	I	I	I	I
Cherry, pin Prunus pennsylvanica				I	I	I	I	I	I	I	I	I
Currant, Black Ribes americanum							I	I	I	I	I	I
Dogwood Cornus stolonifera	I	I	I	I	I	I	I	I	I	III	III	III

Species	TYPE OF REACTION TO: Brush Killer 32 1 lb.	2 lbs.	3 lbs.	Weedone Conc. 48 1 lb.	2 lbs.	3 lbs.	A.C.P. 572 1 lb.	2 lbs.	3 lbs.	A.C.P. 38 1 lb.	2 lbs.	3 lbs.
Golden Bean Thermopsis rhombifolia				IV	IV	III						
Gooseberry Grossularia oxyacanthoi-des	II	II	II	III	II	II	II	II	II	III	III	II
Hawthorn Crataegus succulenta	II	II	I	II	II	II	III	II	I	III	III	III
Hazelnut Corylus rostrata							I	I	I	I	I	I
Honeysuckle Lonicera tatarica				I	I	I	I	I	I			
Ivy, Poison Rhus toxicodendron				II	I	I				II	II	I
Juniper, Creeping Juniperus horizontalis	III	III	III	III	III	III				III	III	III
Juniper, Low Juniperus communis							III	III	III	III	III	III
Juneberry Amelanchier alnifolia				I	I	I	I	I	I	I	I	I
Lilac Syringia vulgaris				I	I	I						
Maple, Manitoba Acer Negundo	II	I	I	II	II	I	I	I	I	III	II	I
Nettle, Stinging Urtica gracilis	II	II	II									
Poplar, White Populus tremuloides				III	II	II	III	III	III	II	II	II

Species	TYPE OF REACTION TO: Brush Killer 32			Weedone Conc. 48			A.C.P. 572			A.C.P. 38		
	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.	1 lb.	2 lbs.	3 lbs.
Poplar, Balsam Populus balsamifera	I	I	I									
Poplar, Russian Populus Petrofskiana				I	I	I	II	II	II	III	III	II
Rosebrush Rosa sp.	II	I	I	III	III	III	II	I	I	IV	IV	IV
Silverberry Elgeagnus argentea	II	I	I	II	II	I	I	I	I	IV	IV	III
Spiraea Spiraea alba	I	I	I	I	I	I	I	I	I	I	I	
Willow, Narrow-leaved Salix sp.				I	I	I	I	I	I	I	I	I
Willow, Broad-leaved Salix Bebbiana				I	I	I	I	I	I	I	I	I

Note: I - Complete top kill, no regrowth.
II - Foliage and most of the small branches are killed but main stems show green and occasional new branches and leaves.
III - Foliage partially killed, branches remained alive.
IV - Plants tolerant to the chemical.

PROJECT VII. INVESTIGATIONS TO DETERMINE POSSIBLE USES AND DEVELOP METHODS OF APPLICATION OF NEW HERBICIDES.

Investigation leader: W. C. Dutton

Summary

Fifty-five abstracts were received for this project but there undoubtedly were many experiments which were not reported or abstracts were not sent for this project. Twenty materials were reported but TCA was indicated much more often than any other. In many instances, code numbers only were used and and since positive information on the identity of the active ingredient is not available, they will be indicated by code numbers or a non-descriptive name. Concise summaries of results follow and more detailed information may be obtained by studying the abstracts. The least promising according to the abstracts, are listed first and the results stated are for each material as used and poor results indicated here should not be intrepreted to mean that a material might not be excellent for some other type of use.

Diesel or fuel oil at 50 and 100 gal/A as pre-emergence treatments on sugar beets reduced stand slightly and gave no weed control, and 178 gal/A gave 30% control of quack. EC 3441 at 2, 4 and 8 lb/A on heading quack gave no control. Potassium cyanate at 10 to 30 lb/A as pre-emergence treatment on sugar beets gave no injury to beets and no weed control. Xanthogen disulfide was reported in pre-emergence treatments in flax, sugar beets, canning peas and corn. With flax 2 and 4 lb/A gave no yield reduction and no weed control. In sugar beets, 5 and 10 lb/A caused malformation of leaves and 5 lb. gave increased yield probably because of some reduction in stand. Weed control is not indicated. It was used at 5 and 10 lb/A on peas but no statement of weed control or effect on peas is given. 4 to 24 lb/A on corn on Brookston soil gave no weed control.

ZBD reported for one experiment on quack, applied when heading and gave less than 5% control for 10 gal. and 20% for 20 gal/A, and in another at various rates gave control ranging from 23 to 65%. Dichloral urea (XP-39-A) in two experiments gave some control of brome grass at 100 and 200 pints/A. As a pre-emergence treatment on sugar beets at 1 to 5 quarts/A there was no control of broadleaved weeds, some control of grass and stand reduction of beets with all rates. IPC applied 20 lb/A to vigorously growing, heading quack gave no control; used as pre-emergence on sugar beets at 5 to 20 lb/A caused no injury and gave no weed control and 2 and 4 lb. on 3-5 in. alfalfa but ahead of weed emergence controlled several grassy weeds but caused some injury to alfalfa.

PCP (pentachlorophenol) in oil at 4, 8 and 12 lb/A as pre-emergence in sugar beets affected stand and vigor with no grass control but some effect on broad leaved weeds at higher rates, but as pre-emergence in corn at 4, 8 and 12 lb/A caused no reduction in yield and 8 and 12 lb. gave good control of crabgrass, foxtail, pigweed and lamb's quarter. Sodium PCP at 8 and 10 lb. in established alfalfa in spring gave no control of annual weeds nor injury to alfalfa. In

an application to onions it reduced stand and yield and in two experiments with sugar beets as pre-emergence treatments it gave no grass control but some of other weeds at higher rates and with injury to beets in one and in the other test there was 80% weed control, reduced stand but higher yield . Herbicide No. 200 used on brome grass sod at 100 and 200 pints per acre gave good results but was less active on a pint to pound basis than Exp. Herbicide No. 2 at 50, 75 and 100 lb/A which gave promising results but was not directly rated in comparison to TCA. In a test on quack at 2 to 8 lb/A Exp. Herb. No. 2 had no effect. Applied to established alfalfa in April it caused browning of weeds and alfalfa at 1 and 4 lb. and as pre-emergence on sugar beets at 2 to 8 lb. gave some weed control and reduction in stand at all rates. Experimental Herbicide No. 1 decreased stand of sugar beets with some weed control, had no effect on quack at 2 to 8 lb. and gave no control of weeds in flax at 2 and 3 lb. and did not affect yield, but as an April application to established alfalfa it gave good control of annual weeds and annual grasses with no injury to alfalfa. K-1131 at 1 and 2 lb. on alfalfa in April gave 60-70% control of weeds and grasses with no injury to alfalfa. Ammonium thiocyanate at 50 and 100 lb/A on quack grass was not equal to sodium TCA at 25 and 50 lb. Tillage increased the kill. Potassium thiocyanate on quack at 100, 200 and 300 lb/A gave 70% control for 200 lb. and 100% for 300 lb.

MCP or toloxy (2-methyl-4-chlorophenoxyacetic or 4-chloro-o-toloxy-acetic acid). In one trial on oats 1 lb. MCP acid equiv. (as isopropyl ester) gave yield reduction the same as or slightly less than 1 lb. 2,4-D acid (as the amine salt) which probably means that MCP would be less toxic to oats than 2,4-D if used in comparable forms. 2,4,5-T gives no indication that it will displace 2,4-D for general use or even equal 2,4-D for everything, but it has given outstanding results for certain uses. Reported results indicate 2,4,5-T probably less active than 2,4-D on field bindweed and definitely inferior on buckbrush. Both at 2 lb/A gave excellent control of hawkweed. 2,4,5-T seems to be definitely superior to 2,4-D on horsenettle and woody species such as poison ivy, brambles (reported previously) and on brush and stumps of many species. Methyl bromide applied under a gas proof cover to soil infested with Johnson, Bermuda and nut grasses gave apparently complete kill of vegetative parts and seeds in soil that had been cultivated and top growth removed but was not so good on undisturbed soil with large top growth. Crops planted soon after treatment made normal growth. Chlorosol A as a pre-emergence treatment on sugar beets at 20 to 80 lb. gave neither weed control nor crop injury. It was used on brome grass sod with no statement of results. 75 lb. and more gave promising results on quack and brome grass and at some rates gave evidence of selective action against different types of weeds. One test on quack grass gave 13 and 15% control for 38 and 77 lb/A as compared to 84% for 80 lb. of TCA. In three other tests on quack rates ranging from 25 to 440 lb/A were ineffective.

TCA in various forms was reported for many uses and any concise summarization of results is very difficult, but an attempt will be made to indicate the general type of results obtained. Twenty to 80 lb. on quack in black raspberries caused light to very severe injury

to the raspberries. Injury to several fruit and ornamental plants was reported last year. Four lb/A on onions as pre- and post-emergence treatments gave some reduction in stand and yield. In one trial in flax indications were that flax yield would be reduced without weed control and in another experiment with flax and rape two applications of 12 lb. of TCA caused visible ill effects on flax or Argentine rape and 8 lb. caused no injury to Polish rape but these rates did not control wild oats and foxtail. A pre-emergence treatment on sugar beets at 10 to 4 lb/A decreased stand and vigor with apparently good weed control. Many crop plants are evidently very sensitive to applications of TCA.

Prickly pear cactus in one trial was controlled 60 to 90 per cent with 50 and 100 lb/A of TCA and blue grama grass was about eliminated. In another test in which the TCA was confined to the cactus plants or adjacent soil, spraying the entire plant at the rate of 2 oz. in 1 qt. of water to 25 sq. ft. (equals 220 lb/A) seemed to be optimum. Four ounces gave no better results. Wild oats and other weeds in flax were not controlled with 6 to 48 lb. rates.

Brome grass sod was well controlled with 75 lb/A of both the sodium and ammonium salts of TCA but several esters at the same rate gave poor control. Results on Johnson grass and Bermuda grass were irregular depending upon when made, clipping and cultivation. Results on Johnson grass were best when applied to top growth 12-18 in. high. Bermuda was not well controlled by April and May applications. 100 lb. seemed adequate for both species. Johnson grass on ditch banks was controlled 87, 93 and 96% with 1, 1½ and 2 lb/sq. rd. applied to uncut tops but Johnson grass seed germinated and caused reinfestation. Johnson grass in alfalfa was treated when 18 in. high with 40 to 160 lb/A. 40, 80 and 100 lb. reduced stand but control was not adequate. 120 and 160 lb. gave excellent kill.

Residual effect of TCA was studied in a few instances. A combination of TCA (50 lb.) and Stoddard solvent (20 gal.) was applied to quack in an area where a lawn was to be established during the summer. Lawn grass was seeded in September and grew normally. Land treated in August, 1948 with 40 to 160 lb/A was seeded to oats and alfalfa in March, 1949. Both grew normally on treated and untreated plots. Annual weeds grew vigorously six weeks after 75 and 100 lb. treatments on June 7. There was above normal rainfall for one month after this treatment. On the other hand soil treated in 1947 with 200 and 400 lb/A still show effects of the treatments in 1949. Plots treated with 200 lb. in 1948 with material applied to foliage show greater revegetation than the same amount was applied to bare soil.

The amount of water in which TCA was used is reported to have some bearing on control, 50, 75, 100 and 200 lb/A, each in 109, 218 and 436 gal/A of water was applied to uncut smooth brome. 50 lb. in 100 gal. was not as effective as 50 lb. in 218 or 436 gal. The various rates were not as consistently good in 218 gal. as in 436. The better results may have been due to more runoff to the soil. Soil moisture seems to be the most important external factor affecting results with quack grass and of internal factors carbohydrate

reserve seems to be important, with low reserve being a favorable condition. Tillage and clipping in conjunction with TCA treatments are important. One report indicates 20 lb/A applied in August, 1948 to plowed and fitted land showed over 90% control in spring of 1949 and 20 to 100 lb. in May, 1949 applied to unplowed and to plowed and fitted land all gave good results but with somewhat better control on plowed areas. In most 1949 experiments with quack TCA was applied to uncut grass. There was one report of better results generally on unmowed grass but another gave best results on mowed grass. There have been reports of better results from clipping. On the other hand with Johnson grass there is evidence that better results are obtained when applied to uncut tops than to clipped grass or in conjunction with tillage. This supports earlier statements that TCA is translocated in Johnson grass. One set of experiments indicated that the efficiency of reduced rates (such as 20 to 40 lb/A) is at least doubled by combining certain tillage practices with it. The value of tillage-TCA combinations is shown in the following tabulation of results on quack grass.

Cultivation	Reduction (per cent) in stand with		
	none	25 lb.	50 lb.
None	--	30	45
Disking	0	74	91
Plowing	10	85	91

This shows a striking benefit from tillage. The TCA was applied on April 20 and plowing and disking were done on May 17.

TCA was used more extensively on quackgrass (couch grass) than on any other species but the methods of use and the results obtained vary so greatly that summarization is difficult. Most of the "special factor" data have been discussed in preceding paragraphs and an attempt will be made here to bring together results of more or less standard applications to uncut quackgrass under many conditions. The results indicated in some abstracts will be difficult to include in such a summary because of the indefinite statement of results. It has been difficult to determine in some cases whether indication of good results refers to immediate top kill or to final regrowth observations.

Applied		Soil Type	Soil moisture		Dosage and control				
Date	Stage		When treated	After	10-20	25-40	50-75	80-125	150-200
Apr.						30	45		
July						x	x	x	x
	heading								
1948						x	x	x	

Applied Date	Stage	Soil Type	Soil moisture when treated	After	Dosage and control 10-20	25-40	50-75	80-125	150-200
1949							xx	xx	xx
	heading						36-68	74-90	
Aug.		pasture				fair	xx	xx	xx
June	heading	sand	good	light	32-90	95		97	
June 4 to 8"		sandy loam	fair	mod.	41-58	82		96	
June	heading	sandy loam	good	dry	32-52	55-63	78	89	
June	heading	"	good	mod.	47-52	93	91	97	
June	heading	loam	good	mod.	57-95	75		97	
June	heading	clay	good	mod.	7-17	17-26	28	42	
June	heading	heavy clay	dry	heavy	27-57	70-73		93	
June	heading	clay loam	fair	heavy	22-23	43-54	62	84	
May					fair	good		good	
April					poor		poor	poor	
June					100		100	100	
Aug.					xx		xx	xx	
May small) June flower) Aug. ripe)					Less than 90 lb. partial control, 90 lb. promising, 120-150 very promising.				

[x]Complete top kill with regrowth in fall.

[xx]Complete top kill with rhizomes alive in fall.

This tabulation indicates poor, indifferent and excellent results. In general 80 to 125 lb/A applied to uncut grass without tillage gave best results and lower rates usually did not give reasonable control. Results were usually better on lighter soils and the effect of moisture content is hard to interpret. The best time to apply is not clearly indicated but one series applied in April gave poor results.

Abstracts of Results of Cooperators

Oat yields following treatment with 2,4-D and MCP. Buchholtz, K. P. Clinton oats was treated with an amine preparation of 2,4-D at rates of 0.25, 0.5, 1.0 and 2.0 lbs. per acre and with 1 lb. per acre of MCP as the isopropyl ester. Applications were all made in 20 gallons of water per acre when the grain was about 12 in. high and starting to shoot. Twenty replications were made and the data were analyzed statistically. Untreated check plots yielded 84.4 bu. of grain per acre. The treated plots yielded 84.6, 82.5, 75.7, 73.2 and 76.6 bu. per acre respectively for the 0.25, 0.5, 1.0 and 2.0 lb. applications of 2,4-D and the 1.0 lb. of MCP. The yields of plots treated with 1.0 and 2.0 of 2,4-D as well as the 1 lb. of MCP are significantly less than check. The 1 lb. application of MCP did not differ significantly from the 1 lb. application of 2,4-D but comparable preparations of the two materials were not used in this trial. Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

The response of quackgrass to applications of TCA and ammonium thiocyanate when combined with cultivation. Buchholtz, K. P. Square rod plots of an undisturbed quackgrass sod were treated with the sodium salt of TCA at rates of 25 and 50 lbs. per acre and with 50 and 100 lbs. per acre of ammonium thiocyanate. One series of plots was left untreated. Portions of the five previous treatments were subjected to no cultivation, one thorough disking and one plowing. The herbicides were applied to the plots in water on April 20. The cultural treatments were made on May 17. Initial infestations were estimated at the time the herbicides were applied. Estimates of the recovery of the quackgrass were obtained in October. Three replicates were used and the data were analyzed statistically. Untreated and uncultivated plots of quackgrass maintained stands of 100 percent during the season. Disked plots had a 100 percent stand and those plowed had a 90 percent stand in October. Uncultivated plots of quackgrass treated with TCA averaged 63 percent of original stand, a highly significant reduction. Stands of plots treated with thiocyanate averaged 103 percent of the original stand in October. Disking or plowing greatly increased the effectiveness of TCA. Plots so treated averaged 18 and 12 percent of original stand respectively. Plots treated with thiocyanate averaged 64 percent of original stand for the disking treatment and 27 percent for the plowing treatment. Differences in stand on plots treated with the different rates of TCA and thiocyanate were usually not significant. Rates lower than those specified might be expected to produce satisfactory results when combined with cultivation. Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin.

Dormant season treatments of brush with 2,4,5-T shows promise. Coulter, L. L. The isopropyl ester of 2,4-D and 2,4,5-T alone and mixtures containing equal amounts of each were applied to standing brush in mid-February 1949. Concentrations of 8000 and 16000 ppm in fuel oil were applied as base sprays (knee high) and as overall sprays. The lower concentrations of 2,4-D regardless of method of application produced some formative effects but control was generally unsatisfactory. A fair degree of control was obtained with the 16000 ppm concentration. In contrast 8000 ppm of 2,4,5-T gave nearly

complete control of such species as oak, ash, cherry, and complete top kill was obtained on basswood. 16000 ppm of 2,4,5-T did not appear to be superior to 8000 ppm. Plots treated with 2,4,5-T failed to produce leaves in the spring while all plots treated with 2,4-D or 2,4-D - 2,4,5-T mixtures did produce leaves some of which died during the course of the summer. 8000 ppm of 2,4,5-T was approximately equivalent to 16000 ppm of the mixture containing 50 percent of each. While some late season regrowth occurred in the 2,4,5-T plots 8000 ppm of this material in fuel oil applied as a base or overall spray was comparable to one standard foliage treatment and shows much promise for dormant season treatment. (Contribution of The Dow Chemical Co., South Haven, Michigan.)

2,4,5-T improves control of stumps sprayed during dormant season. Coulter, L. L. A mixture of oak and maple stumps ranging in size from 4 in. to 27 in. were sprayed with fuel oil mixtures containing 4000, 8000 and 16000 ppm of the isopropyl ester of each 2,4-D and 2,4,5-T as well as equal mixtures of 2,4-D and 2,4,5-T. The 2,4,5-T plots produced sprouts on 7 percent of the stumps while the 2,4-D plots produced sprouts on 47 percent of the stumps. The mixture containing equal amounts of each permitted sprouting on 4 percent of the stumps. 75 per cent of the stumps not treated produced sprouts. There was no greater control where the higher concentrations of any of the chemicals were used. In a similar test on maple stumps averaging 6 in. in diameter where only 4000 and 8000 ppm concentrations were used 2,4,5-T was again outstanding. No sprouts emerged from any stump treated with either concentration of 2,4,5-T or the 2,4-D - 2,4,5-T mixture. Where 2,4-D alone was used, 84 percent of the stumps produced sprouts. These tests seem to demonstrate the importance of 2,4,5-T in a dormant stump control program and the results are consistent with other tests carried out on a similar basis. (Contribution of The Dow Chemical Co., South Haven, Mich.)

Trichloroacetic acid, sodium salt, applied for the control of quackgrass (Agropyron repens) growing in black raspberries. Davidson, J. H. Sprays containing TCA sodium salt were applied at the rates of 20, 40, and 80 pounds TCA equivalent in 300 gallons of water per acre. Applications were made October 21, 1948. The soil was a light sand with a heavy quackgrass sod around the raspberry plants. Rainfall during the fall, winter and early spring was below normal. In the spring of 1949 emerging leaves on the old fruiting canes were small, deformed and chlorotic. These canes died later in the spring. New shoots from the crown appeared normal until mid-summer when they showed definite chlorosis which became progressively worse as the season advanced. This injury was apparent with 20 lb. and severe with 80 lb. Quackgrass control was poor with the 20 lb. and good with 80 lb. (Contribution of The Dow Chemical Co., South Haven, Mich)

Sprays of 2,4-D and 2,4,5-T for the control of horsenettle in orchards. Davidson, J. H. During the past 2 years foliage sprays of 2,4-D and 2,4,5-T containing 2000 ppm of the isopropyl esters were applied as a wetting spray on horsenettle (Solanum carolinense) at various stages of growth. Best control was obtained when the nettle was sprayed during the late blossom period just as some of the small horsenettle fruits were beginning to form. Sprays applied

earlier were ineffective. Observations made the same season as spraying were often misleading as the full effects were not apparent until the following season. Comparative applications of 2,4-D and 2,4,5-T this season applied August 5 during the late blossom period showed much better immediate kill from the 2,4,5-T application. Observations made in October indicated that stems and many roots were dead on the 2,4,5-T treated plots whereas the roots and stems of the 2,4-D plots were still green and succulent. (Contribution of The Dow Chemical Company, South Haven, Mich.)

Final evaluation on the effect of foliage sprays of 2,4,5-T and 2,4-D applied at various periods on poison ivy during the summer of 1948. Davidson, J. H. During 1948 foliage sprays containing 2000 ppm of 2,4-D as the isopropyl ester, the amine and sodium salts and the isopropyl ester of 2,4,5-T were applied as wetting sprays to poison ivy (Rhus toxicodendron) under apple trees. Applications were made at two week intervals throughout the summer. Sprays were applied with a power sprayer at reduced pressures using a nozzle which gave a coarse fan type spray. Best kill was achieved with 2,4,5-T applied August 25, 1948. Applications of 2,4,5-T made June 16 were almost as good but the applications made during July and early August showed a greater amount of regrowth. Of the 2,4-D formulations the ester and amine salt were the best but were definitely inferior to 2,4,5-T. (Contribution of The Dow Chemical Co., South Haven, Mich.)

Response of couch grass (Agropyron repens) to sodium trichloroacetate. Coupland, R. T. A well established stand of couch grass was treated with TCA, sodium salt to give 25, 50, 100 and 150 pounds of active ingredient per acre in 10, 20, 40 and 60 gallons of water, respectively, on July 11, 1949, while the weed was in the vegetative stage. The leaves of the grass were killed within one week at the two heavier rates but were never completely dried up at the lower rates. Regrowth occurred with all treatments but was slowest with the heaviest treatment, where new shoots did not appear until late September. (Contributed from the Laboratory of Plant Ecology, Univ. of Saskatchewan, Saskatoon, Canada.)

Response of flax and rape to TCA, sodium salt. Coupland, R. T. Thirty plots of Royal flax, 30 of Argentine rape and 3 plots of Polish rape were sown on May 10, 1949 in silty clay loam in the dark-brown soil zone at Saskatoon. Each plot consisted of 7 rod rows spaced 6 inches apart. Emergence of flax and rape was delayed until May 25 and June 8, respectively, because of drought. Duplicate treatments were made on Royal flax and Argentine rape with sodium trichloro acetate at 2,4,8 and 12 pounds of active ingredient per acre in 10 gallons of water. Polish rape was treated with 8 pounds per acre in unreplicated plots. Treatments were made on June 21 when the flax was 3 to 4 inches high and the rape was 2 to 3 inches high, on July 7 when the flax and Argentine rape were in the rapidly advancing vegetative stage and the Polish rape was flowering, and were repeated on both dates. No effect of the chemical was observed on any of the crops with respect to vegetative or reproductive development. No yields were taken because of insufficient replication. Under the conditions of this experiment concentrations of sodium TCA up to 12 pounds of active ingredient per acre, even when applied twice during

vegetative stages of development, produced no detrimental effects on Royal flax and Argentine rape. Polish rape showed no response to the chemical when it was applied at 8 pounds per acre, even when the crop was in blossom. Since experiments with Avena fatua and Setaria viridis indicate no damage to these weedy grasses at the same rates, the application of greater concentrations of sodium TCA might be feasible in an attempt to control the latter in flax and rape. (Contributed by the Laboratory of Plant Ecology, Univ. of Saskatchewan, Saskatoon, Canada.)

Johnson and Bermuda grass control with TCA. Elder, W. C. and Stephens, J. P., Jr. 60% sodium trichloroacetate was applied on Johnson and Bermuda grasses at monthly intervals during the growing season at the rate of 50-100-150 lbs. per acre of the active ingredient. Johnson grass was treated at several stages of growth, from closely mowed up to 24" high and also on infested land that had been plowed. Bermuda was clipped 1-2" high before treatment. Application made in May and early June on Johnson grass killed 60-75%. July and August treatments had estimated kills of 90-99%. September and October applications made in 1948 were unsatisfactory on Johnson grass. Some grass recovered from all treatments, with the 50 lb. rate always showing the most: however, the 150 lb. rate did not show advantage over the 100 lb. rate. This investigation indicated that clipping Johnson grass or cultivation of the soil just before treatment gave less control than when the grass was 12-18" high at time of treatment. Bermuda grass applications made in April and May were unsatisfactory, but very good for June, July, August, September, and October. Some recovery was noticeable on 50 lb. per acre plots. Rates above 100 lbs., however, did not show an advantage. (Contributed by Agronomy Department of the Oklahoma A. & M. College Exp. Station.)

Effect of methyl bromide on Bermuda, Johnson and nut grass. Elder, W. C. Methyl bromide containing 2% chloropicrin was released under gas-proof paper covering the grasses. The paper was removed after 30-40 hours exposure. Rates of 1 lb. per 100 sq. ft. were used on all grasses and 1/2 lb. was used on Bermuda grass. Applications were made on moist soils. Plots were on infested areas where the soil had been recently cultivated and on undisturbed soil with some of the growing vegetation exposed. Bermuda and Johnson grasses were killed by all treatments except where the vegetation was large at time of treatment. Where the grasses were clipped close to the ground and the forage removed from the area, eradication was complete. The nut grass plots were treated late in the season and final readings cannot be made until next year: however, the treatments look promising since the area is free of new growth 90 days later. Twenty-four hours after the covers were removed from the treated areas, crops were planted and made normal growth. Evidently many of the weed seed were killed by the gas as the cultivated plots were free of weeds the entire summer. (Contributed by Agronomy Dept. of the Oklahoma A. & M. College Experiment Station.)

Tip immersion studies on mesquite (Prosopis juliflora). Fisher, C. E. and Dale W. Young. The tip immersion test is a rapid method of testing the translocation of herbicides when a constant supply of herbicide is made available for absorption by the

plant. The tip immersion method consists in immersing the tip of a branch into a jar of herbicide for a period of 1 to 24 hours and noting translocation of the herbicide by the effect on the plant tissue. Various formulations of herbicides have been tested on mesquite at two-week intervals throughout the greater part of the year. Some results are apparent. 1. There is a wide range in the amount and distance of translocation from the time the tree comes into leaf in the spring until frost. 2. There has been no translocation of the ester of 2,4-D in oil and only a limited amount of translocation of 2,4,5-T in oil. 3. Oil emulsions of the amines and sodium salt of 2,4-D translocate much farther and faster than water solutions of the materials. 4. The addition of a wetting agent to a water solution of the salts of 2,4-D increased translocation of the material as much as the addition of an emulsifiable oil. 5. The addition of 5 to 20 percent oil to an emulsion of an ester of 2,4-D or 2,4,5-T did not increase translocation of the material. 6. Sodium TCA will translocate in mesquite, but it defoliates and does not kill the tissue. 7. Chlorosol A will translocate in mesquite and it does kill the tissue of mesquite. 8. Ammonium sulfamate will translocate in mesquite and kill the tissues of mesquite. 9. There is no translocation when the mesquite is dormant. (Contributed by the Texas Agricultural Experiment Station, Spur, Texas and the U. S. Bureau of Plant Industry, Soils, and Agri. Engineering, Spur, Texas.)

Effect of TCA on perennial grasses. Friesen, H. A. Sodium TCA was sprayed at rates of viz: 20, 40, 80, 100 and 160 pounds per acre on established patches of quack grass (Agropyron repens) just prior to heading of the grass. The top growth was effectively killed by all rates. Root kills were incomplete, eight weeks after treatment all plots showed 5 to 15 percent recovery. All plots, except the one treated at 80 pounds per acre, were one-way disked at a depth of five inches in late August, two months after treatment. Much of the disked up root material appeared to be still in a viable condition. The untilled plot was retreated at 80 pounds per acre in late July. Subsequent regrowth was not observed on this plot. All rates of TCA had a severe stunting effect on the Russian thistle (Salsola Kali) and red root pigweed (Amaranthus retroflexus) growing around the plot margin. The 80 pounds per acre of TCA resulted in a killing of the top growth of crested wheat (Agropyron cristatum) with no sign of recovery in 1949. (Contributed by the Dominion Experimental Station, Scott, Sask. 1949.)

Effects of TCA and PCP, sodium salt, on onions. Grigsby, B. H. TCA, sodium salt applied at the rate of 4 lbs/A was used as a pre-emergence treatment and as a post-emergence treatment. In the latter case the onions had developed two true leaves at the time of spraying. Slight reduction in number of onion plants per foot of row was found when TCA was applied as either a soil treatment or as a selective spray. No noticeable effects were observed on the onion bulbs at harvest time but yields were less than those in untreated plots. PCP, sodium salt, 2% solution at 100 gal/A produced severe stand reductions and also reduced yields. (Contribution from Michigan Agricultural Experiment Station.)

Control of orange hawkweed in a pasture by the use of 2,4-D and 2,4,5-T. Grigsby, B. H. In a cut-over pasture heavily infested with hawkweed and brake fern, areas of approximately 1/10 acre were sprayed in June with an ester of 2,4-D and 2,4,5 ester in an aromatic oil-water emulsion. The herbicides were used at the rate of 2 lb. per acre and the total volume of spray solution was 50 gal. per acre. Control was obtained with both herbicides and a good growth of grass filled in the sprayed area. No regrowth of hawkweed was apparent when the plots were examined in October. (Contribution from the Michigan Agricultural Experiment Station.)

The use of TCA for the control of quack grass in uncultivated areas. Grigsby, B. H. Heavy sod of quack grass in light sandy soil was sprayed with TCA, sodium salt, at East Lansing and Lake City. The grass in each case was in the early flowering stage. TCA, 30 lbs/A gave control for a 60 day period but an estimated regrowth of 40% was apparent in 90 days. Much of this new growth, however, appeared to be new seedlings and only occasional tufts from old rhizomes were found. TCA at 50 lbs/A was applied to an area where a lawn was to be established. In this case 20 gallons/A of Stoddard Solvent were added and the mixture applied as an emulsion. A complete kill of quack grass was obtained and lawn grass seed was sown in September. No injurious effects of TCA on the grass seedling were observed and the area now is a satisfactory lawn. (Contribution from the Michigan Agricultural Experiment Station.)

Studies on the herbicidal action of TCA. Helgeson, E. A. Richard Konzak and Robert Thacker. Quack grass plots treated with TCA at rates from 25 to 100 lbs./acre acid equivalent in 1948 showed complete regrowth in 1949. Additional quack grass plots sprayed at rates from 50 to 150 lbs./acre with acid (sodium salt) the past summer showed complete top kill by fall at 100 lbs. or more. In all cases live and apparently healthy rhizomes were present on October 29. Owing to the dry summer season the chemical may not have penetrated deeply enough to kill under ground parts. (Contrib. N. D. Agricultural College.)

Some observations on the herbicidal effects of Chlorosol A. Helgeson, E. A. and Robert Thacker. During the past summer quack grass and bromegrass were sprayed with aqueous solutions of Chlorosol A at rates varying from 50 to 150 lbs. per acre active ingredient. Top kill increased progressively with increasing concentrations with no regrowth evident at rates above 75 lbs. Germination tests with wheat barley, corn, soybeans and field peas planted in soils treated at concentrations from 2 to 250 ppm. showed no consistent retarding effect up to 15 ppm. At 15 ppm. and up a gradual decrease in germination and seedling development occurred. Tops of well developed plants of small ragweed, wild lettuce, curled dock and Canada thistle were completely killed when sprayed with a solution of 1 lb. per gallon water. Leaves but not stems of golden rod, annual and perennial sowthistle, pigweed and kochia were killed by above spray and dogbane, kinghead, marsh elder, and stinging nettle showed little effect 16 days after spraying. (Contrib. N. D. Agric. Coll.)

TCA and ammate on prickly pear cactus (Opuntia humifusa) Raf. Klingman, Dayton L. and Shafer, Neal E. Prickly pear infesting a mixed blue grama and sand dropseed pasture in central Nebraska was sprayed September 30, 1948. Triplicate plots 12 feet by 50 feet were sprayed with a jeep-mounted sprayer using 50 pounds pressure per square inch. Ammate was applied at three rates, 40 pounds per acre, 80 pounds per acre, and 120 pounds per acre, using 100 gallons of water per acre for the first two rates and 200 gallons per acre for the 120 pound per acre rate. TCA was applied at 50 pounds per acre and 100 pounds per acre as the ammonium salt, and 50 pounds per acre and 100 pounds per acre as the sodium salt. The 50 pounds per acre rates were applied in 100 gallons of water per acre: however, 200 gallons of water per acre were used for the 100 pounds per acre rate since this rate was obtained by spraying twice with the 50 lb. rate. Notes on the cactus and blue grama were taken in May, 1949. In the plots of 50 and 100 pounds of sodium TCA, 60 per cent to 90 per cent of the cactus was dead with an occassional new shoot in evidence. The grass appeared to be 100 per cent eliminated. 40 lbs. of ammonium sulfamate killed 50 per cent of the grass with no apparent reduction in the number of cactus. Eighty pounds of ammonium sulfamate also killed 50 per cent of the grass, while accomplishing a 10 per cent to 15 per cent reduction in cactus. Ammonium sulfamate at 120 lbs. was similar to the 80 lb. rate. All surviving grass had a slightly chlorotic appearance. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A., and the Dept. of Agronomy, Nebraska Agr. Exp. Sta., Lincoln, Neb.)

Comparison of 2,4-D and 2,4,5-T for control of buckbrush (Symphoricarpos occidentalis). Klingman, Dayton L. The ethyl ester of 2,4-D and 2,4,5-T was sprayed on eight by ten foot plots of buckbrush June 4 and July 13, 1948, at rates of 1 and 2 lbs. acid in 40 gallons of water per acre. Plots located near Lincoln, Nebraska. 2,4-D was greatly superior to 2,4,5-T for control of buckbrush giving an average control of 64 per cent and one per cent, respectively, according to notes taken June 2, 1949. 2,4-D sprayed June 4, 1948 at one pound gave 75 per cent control, 2 lbs. gave 66 per cent: 2,4-D sprayed July 13, 1948 at 1 lb. gave 68 per cent control and two pounds gave 55 per cent (biased upwards by only 5 per cent control in one replication). Differences between rates and dates of application above were not statistically significant. 2,4,5-T treatments gave two per cent or less control at all rates and dates. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.).

The effect of treating leafy spurge (Euphoriba esula) with various boron compound at several rates of application in Kingsbury County. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized [illegible] 10 by 10 foot plots of leafy spurge (Euphoriba esula) were treated in duplicate with 16.34, 21.78 or 27.23 pounds per square rod of Borascu: 8.17, 10.89, 13.61 or 16.34 pounds of anhydrous razorite: 8.17, 10.89, 13.61, 16.34, or 5.45 lbs. of Polybor: and 8.17, 10.89, or 13.61 lbs. of Polybor-chlorate. Treatment was made June 2, 1949 when the leaf spurge was starting to bloom. Counts were made August 26, 1949. Per cent elimination was figured by comparing treated plots to untreated. At the time of counting, regrowth on the plots was stunted. All formulations gave

an 80 per cent or better elimination except the Polybor at the 5.45 pound rate. The Borascu eliminated 94.21 to 98.84 per cent of the spurge: the anhydrous razorite 86.10 to 98.46 per cent. In the plots treated with these two formulations there was an excellent growth of Kentucky Blue grass (Poa pratensis.). Polybor eliminated 54.83 per cent at the 5.45 pound rate; up to 96.91 per cent at the 13.61 and 16.34 pound rates. At the lower three rates of Polybor there was a fair stand of grass remaining. The highest two rates of Polybor and all rates of Polybor - chlorate eliminated a high per cent of the grass. Polybor - chlorate varied in per cent elimination of leaf spurge from 86.49 to 98.07 per cent. Results indicate all formulations of boron compounds to be about equal in eliminating spurge; however the rates required may vary. (Contri. by the Agronomy Dept. of the South Dakota Exp. Sta. and the Bureau of Plant Industry, Soils, and Agri. Eng., U.S.D.A.)

The effect of treating wild oats (avena fatua) seeded with flax with TCA at four rates of application and TCA - 2,4-D mixture at two rates of application at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized 4 foot by 8 foot plots of flax were treated in triplicate with Sodium trichloracetate at 6, 12, 24, and 48 pounds of the acid per acre and a mixture of TCA 12 pounds per acre plus triethanol amine salt of 2,4-D ¼ pound per acre and TCA 24 pounds plus 2,4-D ¼ pound per acre. Half of the number of plots were seeded to Wild oats (avena fatua) and other annual weeds at the same time the flax was seeded. An extremely dry period prevailed immediately after seeding preventing germination and stunting the germinated plants both flax and weeds. Treatment was made June 6, 1949 when the flax was 8 inches tall and the wild oats and other weeds were 2 to 3 inches high. Weed counts were made on June 28, 1949. Results indicate at no rate of the TCA alone was there any material control of wild oats and other weeds. When 2,4-D was mixed with TCA the annual broadleaf weeds such as lambs quarters (chenopodium album) and Kochia (Kochia scoparia) were eliminated nearly 100 per cent. An analysis of variance of the yields indicated a significant difference in treatments. An L.S.D. at the 1 per cent level showed all treatments in the wild oats plots except TCA at 6 pounds per acre to have reduced the yields significantly. TCA at 48 pounds on the wild oats free flax lowered the yield significantly at the 1 per cent level. TCA at 12 pounds plus 2,4-D ¼ pound lowered the yield significantly at the 5 per cent level. Results indicate TCA will reduce flax yields without controlling the grassy type weeds. (Contri. by the Agronomy Dept. of the South Dakota Agri. Exp. Station and the Bureau of Plant Industry, Soils, and Agri. Eng.).

The effect of various chemicals at several rates of application applied as pre-emergence sprays on flax at Brookings. Kratochvil, D. E., Lyle A. Derscheid, and L. M. Stahler. Randomized 4 foot by 16 foot plots of flax were treated in triplicate 4 days after seeding and 7 days after seeding with 1 or 1½ pounds acid per acre of triethanol amine salt or micronized acid of 2,4-D; 2 or 3 pounds acid per acre of Experimental herbicide No. 1; 2 or 4 pounds per acre of Sulfosan; 20 or 40 pounds acid per acre of TCA; 8 or 16 pounds in water or 8 pounds in oil of PCP. Wild oats (Avena fatua) and other common annual weeds were sown with the flax on one-half of each plot. Weed counts were made on June 28. Extreme

drought conditions reduced flax yields. No material difference was found in weed counts between untreated and treated plots. An analysis of variance indicates that yields were changed by rates of some chemicals and an L.S.D. at the 5% level indicates the TCA at 20 or 40 pounds per acre and PCP at 8 pounds in water lowered the yields significantly when applied 4 days after seeding. TCA at 40 pounds per acre significantly lowered the yield when applied 7 days after seeding. (Contributed by the Agronomy Dept. of the South Dakota Agri. Exp. Station and the Bureau of Plant Industry, Soils and Agri. Engineering, U.S.D.A.)

The effect of treating quackgrass (Agropyron repens) with several herbicides, Brookings, South Dakota, 1949. Kratochvil, D. E., Lyle A. Derscheid and L. M. Stahler. Sodium trichloroacetate at rates of 50, 75, 100 and 125 pounds acid per acre; isopropylphenyl-carbamate at 20 pounds per acre; E.H. No. 1, E.H. No. 2 (Carbide and Carbon Chemical Corp.) and E.C. 3441 (Sharples Chemical) at 2, 4 and 8 pounds per acre; Chlorosol-A at 25, 50 and 100 pounds per acre; 7BD (General Chemicals) at 10 and 20 gallons per acre; Polybor-chlorate at 500 and 800 pounds per acre were applied to vigorously growing quackgrass in early summer when the grass was heading. All herbicides were applied in 40 gallons water per acre except 7BD which was applied in 40 gallons fuel oil and the Polybor-chlorate in 480 gallons water per acre. Precipitation following application was limited. Visual estimation of kill October 10, 1949 showed better than 90% elimination where 125 pounds TCA acid per acre was applied, 74% for 100 pounds, 68% for 75 pounds and 36% where 50 pounds was used. 7BD at 10 gallons per acre gave less than 5% control of quackgrass: 20% control at 20 gallons per acre. 320 pounds per acre of Polybor-chlorate gave less than 5% reduction: 640 pounds 50% elimination. None of the other herbicides showed any herbicidal effect on quackgrass four months after application. (Contributed by the South Dakota Agri. Exp. Station and the Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.)

Effect of TCA on Johnson grass (Sorghum halepense). Lee, Oliver C. Replicated plots of Johnson grass were treated with TCA, sodium salt at rates of 40, 80, 100, 120 and 160 pounds of acid per acre in August of 1948. The area treated was located in an alfalfa field that had been clipped twice during the summer. Johnson grass at the time of treatment was approximately 18 inches in height. All rates of applications destroyed top growth. The following spring the area was disked and seeded to oats and alfalfa. In August of 1949 an average of 3 plants of Johnson grass per square rod were found on plots treated with 120 and 160 pounds of TCA. Amounts of 40, 80 and 100 pounds reduced the stand of Johnson grass but is not considered adequate control or eradication. Oats and alfalfa seed in March of 1949 grew normally on all treated and check plots. Other plots were treated in June, July and September of 1949 using rates of 40, 80 and 100, 120 and 160 pounds of TCA acid per acre. One series of plots sprayed on September 21 were disked twice to keep down top growth during August and September prior to spraying. Results of 1949 sprayings will be determined in 1950. (Contributed by Dept. of Botany and Plant Pathology, Agric. Expt. Sta., Purdue University).

Response of quack grass (Agropyson repens) to treatments of TCA. Lee, Oliver C. Plots of quack grass were treated with TCA, sodium salt at rates of 40, 60, 80, 100, 120, and 150 pounds of acid per acre. Sprays were applied on August 3, 1949. Plots were located in a permanent pasture that had been closely grazed during the summer. No green growth appeared the middle of October on plots treated with 6[illegible] pounds or more per acre. A few green plants were present on the plots receiving 40 pounds of TCA. Live stolons are still present on all plots. This experiment was repeated on an area where quack grass had grown undisturbed during the summer. Sprays were applied August 10. Treatments on this area did not appear to be as effective as the one just described. Heavier applications were required to produce a comparable kill of quack grass. Applications of 150 pounds was the only rate that prevented resprouting when observed on October 14. (Contributed by Dept. of Botany and Plant Pathology, Agric. Expt. Sta., Purdue University.)

The relationship between spray volume and the effectiveness of TCA as a grass killer. McCall, G. L. and J. W. Zahnley. The sodium and ammonium salts of TCA were applied to a very heavy stand of smooth brome grass at rates of 50, 75, 100 and 200 lbs. of the salts per acre. These dosages were applied to the uncut tops of the grass in varying volumes of water. Volumes used were 109, 218 and 436 gallons per acre. Sodium or ammonium TCA applied to brome grass at the rate of 50 lbs. per acre in 109 gallons of water was not as effective as the same materials applied at the same rate in 218 or 436 gallons of water per acre. Results achieved with the various dosages of sodium and ammonium TCA applied in 218 gallons of water per acre were not as consistently good as the same dosages applied in 436 gallons per acre. There was no significant difference between results obtained with the two salts. When ammonium and sodium TCA are applied to the uncut tops of brome grass the increased effect obtained with the higher volumes of water used is probably due to increased run-off of the materials onto the soil. These differences due to volume of spray liquid used are most noticeable at the 50 lb. per acre rates which may be borderline for brome grass control. (Contribution of the Kansas Agricultural Exp. Station.)

TCA for the control of Johnson grass along irrigation ditch banks. McCall, G. L. and J. W. Zahnley. Sodium TCA, applied June 30, 1949, at the rates of 1, 1½ and 2 lbs. per square rod to the uncut tops of Johnson grass growing along irrigation ditches successfully eliminated 87, 93 and 96 percent respectively of the established stand. Although for practical purposes the original stand was controlled, Johnson grass seed in the soil germinated the following spring and the plants made normal growth. TCA will control established stands of Johnson grass but retreatment will be necessary to control seedlings. It may be desirable to apply somewhat less in the original treatment and use dosages in the neighborhood of 50 lbs. per acre the following year to eliminate the surviving old plants and seedlings. (Contri. of the Kansas Agricultural Exp. Station.)

The long-term effect of TCA upon the soil. McCall, G. L. and J. W. Zahnley. Recent results have shown that under certain conditions the effect of TCA may persist in the soil much longer than has previously been suspected. Areas treated in 1947 with ammonium or sodium TCA at rates of 200 and 400 lbs./acre on ground from which the weeds were removed still show the effects of the treatment. Although surrounded by various species of weeds the plots do not exhibit infestation to the same degree as do the surrounding untreated areas. This would indicate that some measure of soil sterility persists. Plots treated in 1948 with 200 lbs./acre of both salts applied to foliage show a greater degree of revegetation than do the plots where material was applied at the same rate to the bare soil. It was also noted that the plants reinfesting the treated plots were mainly broad leaved weeds and shallow rooted grasses. (Contribution of the Kansas Agricultural Exp. Station.)

The effectiveness of various experimental chemicals for the eradication of grass. McCall, G. L. and J. W. Zahnley. A number of experimental herbicides were applied as solutions or suspensions to an area covered with a heavy bromegrass sod. The materials were applied on June 20, 1949 to test their effectiveness as grass killers. Materials tested included trichloroacetic acid, its sodium and ammonium salts and its ethyl, isopropyl and "lorol" esters, "Chlorosol A", Carbide and Carbon Experimental Herbicide No. 2, Standard Agricultural Chemicals Herbicide No. 200 and Sherwin-William's XP-39-A. All materials were tested at 50, 75 and 100 lbs. per acre active with the exception of Herbicide 200 and XP-39-A which were tested at 100 and 200 pints per acre. Preliminary results indicate that there is little difference in results obtained with TCA and its ammonium and sodium salts. All looked good at 75 lbs. per acre. The ethyl, isopropyl and "lorol" esters of TCA gave poor control at the same dosages. Carbide and Carbons Experimental Herbicide No. 2 appeared quite promising. Herbicide 200 and XP-39-A caused similar response in the treated plants but were less active than Experimental Herbicide No. 2 compared on a pint to pound basis. (Contribution of the Kansas Agricultural Experiment Station.)

The comparative effects of fall treatments 2,4-D and 2,4,5-T upon field bindweed, Convolvulus arvensis. McCall, G. L. and J. W. Zahnley. Replicated plots of bindweed were treated on October 22, 1948, with the isopropyl esters of 2,4-D or 2,4,5-T. The 2,4-D was applied at rates of 1, 2 and 3 lbs. of acid per acre and the 2,4,5-T was applied at the rate of 2 lbs. of acid per acre. Each treatment was applied in straight water, straight diesel fuel and in a fifty-fifty mixture using a volume of 40 gallons per acre. Results were excellent with an average reduction in stand for all treatments of more than 90%. Two and three pounds of 2,4-D acid per acre were no better than, if as good as 1 lb. of acid per acre. Their average reduction in stand being less than that of the 1 lb. rate. 2,4,5-T treatments were no better than comparable treatments of 2,4-D. On the average, they tended to allow a somewhat larger percentage regrowth of bindweed. The straight diesel fuel or the fifty-fifty water diesel fuel mixture were no better than straight water when used as the media for applying 2,4-D or 2,4,5-T. (Contribution of the Kansas Agricultural Experiment Station.)

Treatment of quack grass with TCA in 1949 at Huron, South Dakota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 8 at 10, 20, 40 & 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod but rough from plowing 2 years previous. Light sandy soil. At time of treatment soil moisture was good with quack starting to head at 18 in. Following treatment, June precipitation was 1.41 in.; July 0.99; Aug. 2.60; Sept. 2.29. Estimated reduction of top growth on September 13: 10 lbs. 32%; 20 lbs. 90%; 40 lbs. 95%; 80 lbs. 97%. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA in 1949 at Lily, South Dakota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 9 at 10, 20, 40 & 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was mostly covered with quack grass sod. One set of replications on rough ground because of plowing at least two years previous. Sandy loam soil. At time of treatment soil moisture was fair and quack 4 to 8 inches high. Following treatment, June precipitation was 1.25 inches; July 3.35; Aug. 0.25; September 2.25. Estimated reduction of top growth on September 13: 10 lbs. 41%; 20 lbs. 58%; 40 lbs. 82%; 80 lbs. 96%. Plot area was rolling with better control noted at all rates on higher ground. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA in 1949 at Starkweather, North Dakota. MacDonald, W. P., Slough, A.T., Zinter, C. C. Seventy percent sodium TCA was applied June 16 at 10, 20, 30, 40, 60 & 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod but very rough from plowing the previous season. Sandy loam soil. At time of treatment soil moisture was good with quack 10 to 14 in. high and heading. Record of precipitation following treatment not available but it was considered a very dry season in the area. Estimated reduction of top growth on September 14: 10 lbs. 32%; 20 lbs. 52%; 30 lbs. 63%; 40 lbs. 55%; 60 lbs. 78%; 80 lbs. 89%. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis.)

Treatment of quack grass with TCA in 1949 at Baldwin, North Dakota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 8 at 10, 20, 30, 40, 60 and 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. per acre. Area treated was completely covered with quack sod and had not been disturbed for several years. Good sandy loam soil. At time of treatment, soil moisture was good with quack 10 to 14 inches high and heading. Following treatment, June precipitation was 0.56 inches; July 2.70; Aug. 1.86

Sept. 0.32. Estimated reduction of top growth on September 13: 10 lbs. 52%; 20 lbs. 47%; 30 lbs. 80%; 40 lbs. 93%; 60 lbs. 91%; 80 lbs. 97%. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA in 1949 at Redwood Falls, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 7 at 10, 20, 40 and 80 lbs. of acid equivalent per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod which had not been disturbed for several years. Good loam soil. At time of treatment soil moisture was good with quack 18 in. high and heading. One-half of each plot was mowed and the hay removed. Following treatment, June precipitation was 1.08 inches; July 3.82; Aug. 1.37; Sept. 0.92. Estimated reduction of top growth on September 12: 10 lbs., mowed, 40%--unmowed 37%; 20 lbs., mowed 50%--unmowed 95%; 40 lbs., mowed 58%--unmowed 75%; 80 lbs., mowed & unmowed, 97%. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA in 1949 at Warren, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 16 at 10, 20, 30, 40, 60 and 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was uniformally covered with quack and other perennial grasses. It was part of a golf course which had not been disturbed for several years. Fairly heavy clay soil. At time of treatment soil moisture was good with quack 6 to 8 in. high and heading. Following treatment, June precipitation was 1.87 inches; July 3.44; Aug. 1.99; Sept. 0.50. Estimated reduction of quack top growth on Sept. 15: 10 lbs. 7%; 20 lbs. 17%; 30 lbs. 26%; 40 lbs. 17%; 60 lbs. 28%; 80 lbs. 42%. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA in 1949 at Breckenridge, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 14 at 10, 20, 30, 40 and 80 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was completely covered with quack sod and had not been disturbed for two seasons. Heavy clay soil. At time of treatment the soil was dry with quack heading at 6 to 9 in. Following treatment, June precipitation was 0.32 inches; July 9.91; one rain inundated the plots for several days. Estimated reduction of top growth on September 16: 10 lbs. 27%; 20 lbs. 57%; 30 lbs. 70%; 40 lbs. 73%; 80 lbs. 93%. September readings made difficult by an extremely heavy stand of setaria which had completely taken over the plots. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis).

Treatment of quack grass with TCA, #1 fuel oil, Chlorosal-A, and General Chemical 7B-D in 1949 at Halstad, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent TCA was applied June 23 at 10, 20, 30, 40, 60 and 80 lbs. of acid equiv. per

acre. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Chlorosal-A was applied at 38.5 lbs. and 77 lbs. of active ingredient per acre. General Chemical 7B-D was applied at 20 gal. with 69 gal. of fuel oil; 20 gal. with 158 gal. of oil; 15 gal. with 118.5 gal. of oil; 10 gal. with 79 gal. of oil; 10 gal. with 168 gal. of oil and 178 gal. of #1 fuel oil was applied without additives. Area treated was completely covered with quack and other grasses and had not been disturbed for two years. Heavy clay loam soil. At time of treatment soil moisture was fair and quack heading at 24 in. Following treatment, June precipitation was 0.38 inches; July 7.63; Aug. 1.35; Sept. 0.48. Estimated reduction of top growth on Sept. 16: TCA - 10 lbs. 22%; 20 lbs. 23%; 30 lbs. 43%; 40 lbs. 54%; 60 lbs. 62%; 80 lbs. 84%. Chlorosal-A - 38.5 lbs. 13%; 77 lbs. 15%. General Chemical 7B-D - 20 gal. 69 gal. oil 40%; 20 gal. 158 gal. oil 65%; 15 gal. 118.5 gal. oil 27%; 10 gal. 79 gal. oil 23%; 10 gal. 168 gal. oil 55% and 178 gal. #1 fuel oil without additives 30%. Presence of other perennial grasses complicated plot readings. June grass stands relatively undamaged. One month after treatment all chemicals and rates showed better than 90% control of top growth. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis.)

Use of herbicides for annual weed control in alfalfa. Shafer, Neal E. Annual weeds such as kochia, pigweed, lambsquarters, downy brome, and little barley are often a problem in the first cutting of alfalfa in Nebraska. Later cuttings may be troubled with quantities of foxtail, barnyard grass, and crabgrass. Nine different herbicides were applied to duplicate 8' x 16' plots. Treatment was made April 19 when the alfalfa was from emerging to 3-5 inches in height, but prior to emergence of most weed species. Many weed species were delayed in germinating by the presence of a cover of weed residue left from the previous year. This residue was burned April 9. Sinox general and K-1131 at 1 and 2 pounds and Sinox W and Dow selective at 4 and 8 pounds gave 60 to 70 per cent control of all weeds for approximately four weeks with no harmful effect on the alfalfa. One pound of 2,4-D sodium salt gave 80 to 90 per cent reduction in broadleaf species and 50 to 60 per cent reduction in grassy weeds with no visible effect on the alfalfa. Weed control through herbicidal action competition of the alfalfa lasted until the alfalfa was cut. Carbon and Carbide Company's Herbicide No. 1 at 1 pound and 4 pounds per acre also gave good weed control (60 to 90 per cent) without injury to the alfalfa. Herbicide No. 2 caused a browning of weeds and alfalfa at rates of one pound and 4 pounds per acre. IPC at 2 and 8 pounds per acre effectively controlled little barley, green and yellow foxtail, and barnyard grass with injury to the alfalfa. Sodium pentachlorophenate at 8 and 10 pounds per acre caused no damage to weeds or alfalfa. (Contribution of the Dept. of Agronomy, Nebraska Agricultural Exp. Station.)

TCA on quack grass at low doses. Shaw, W. C. and C. J. Willard. Sodium TCA at 20 pounds per acre applied to quack grass infested soil in August 1948, at once after plowing and working down to a seed-bed, (1948 Res. Report, Abstract VII-13) resulted in over 90% control when examined this spring. On May 15, 1949, sodium TCA was applied at 20, 40, 80, and 100 pounds per acre to both recently plowed and fitted and unplowed quack. All rates were effective, the

kill on the plowed areas being somewhat better than on the unplowed. A few sprouts are visible now (October) in all plots, nearly as many in the 100 lb. plots as in the 20 lb. plots. A second test in August 1949, followed by three weeks of dry weather, appeared less effective, but no final results are yet available. (Contribution of the Ohio Agricultural Exp. Station.)

Effects of new chemicals on quackgrass (Agropyron repens). Slife, F. W. and Fuelleman, R. F. Chlorosol A was applied to established stands of quackgrass in June of 1949 at 25, 50, 75, and 100 pounds per acre. Three weeks later a slight discoloration of leaves was evident. Observations on October 17, indicated little or no damage to the quackgrass at any of the above rates. Potassium thiocyanate was used at 100, 200, and 300 pounds per acre on quack grass. Applications were made in June and August. Applications of 300 pounds on both dates have given 100 percent control and 200 lbs. have given 70 percent control. Nitrogen in the form of ammonium nitrate has been applied to quackgrass in combination with other chemicals. Applications of 80 pounds elemental nitrogen plus 25 pounds TCA, 80 pounds N plus 50 pounds TCA, 80 pounds N plus 4 lbs. 2,4-D, and 80 pounds N plus 8 pounds of 2,4-D, were made in June of 1949. The 2,4-D-nitrogen combination gave control all season, but did not reduce the stand to any extent. TCA-nitrogen gave only partial control. (Contribution of the Illinois Agricultural Exp. Station, Urbana, Illinois.)

Control of quackgrass (Agropyron repens) with TCA. Slife, F. W. and Fuelleman, R. F. The sodium salt of TCA has been applied to established stands of quackgrass in April, June, and August of 1949 at Urbana, Illinois. Rates used were 25, 50, 75 and 100 pounds of the acid per acre. None of these rates were effective when applied on April 7. TCA applied on June 7 to previously clipped quackgrass at the rate of 75 pounds per acre gave 100 percent control. Rates as low as 25 pounds per acre applied in August destroyed all top growth, but on October 19, examination of the rhizomes on all plots indicates that regrowth has again started. Rain fell within 2 days after the June 7 application and continued above normal during the ensuing month. Six weeks after the June 7 application annual weeds began to grow vigorously on the 75 and 100 pound plots. The weeds were crabgrass (Digitaria sp.), witch grass (Panicum sp.), and tumbleweed (Amaranthus sp.). In northern Illinois at the DeKalb Experimental Field, applications made in June were less effective; only 90 percent control was obtained with 125 pounds of TCA acid per acre. Complete control was obtained when 150 pounds per acre was used. This area was not clipped before treatment and rainfall was well below normal during the summer. A few annual weeds appeared on the 75 and 100 pound plots in late September. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Effect of several boron formulations as herbicides for control of leafy spurge (Euphorbia esula), Brookings, South Dakota, 1949. Stahler, L. M., D. E. Kratchovil, and L. A. Derscheid. Borascu at 15 pounds per square rod; Razorite at 10, 15 and 20 pounds per square rod; Polybor at 10 and 15 pounds per square rod; Polybor-chlorate at 5 and 10 pounds per square rod were applied to replicated plots of leafy spurge in early bloom stage on May 25, 1949.

All materials except the Polybor-chlorate were applied dry - it is a spray solution. Ample precipitation in the last half of May was followed by a dry summer and fall. Plots treated with 15 pounds Borascu--which consistently eliminates 95 to 100% of spurge plants--showed 10% survival on October 1, 1949, while Razorite at 10, 15 and 20 pounds showed 5, 10 and 10% survival respectively. Polybor-chlorate at 5 and 10 pounds showed 60 and 20% survival respectively; Polybor at 10 and 15 pounds showed 40 and 5% survival respectively. Herbicides were furnished by Pacific Coast Borax Company. (Contri. by Bureau of Plant Industry of U.S.D.A. and Agronomy Dept. of South Dakota State College.)

Pre-emergence chemical weed control in sugar beets at Fargo-Moorhead, 1949. Swanson, C. R., E. A. Helgeson, R. Konzak and L. M. Stahler. Chemicals applied at planting and 4 days after. Na TCA applied at 10, 20, 30 and 40 lbs./acre. Beet stand and vigor decreased with increasing concentration of the herbicide. There appeared to be good weed control. Sinox 20 applied at 1, 1½ and 2 lbs/acre using water-diesel-oil and water as carriers. Beet stand was reduced slightly at lowest rate and more at higher rates. No weed control. E. H. No. 1 applied at 1, 2 and 4 lbs./acre. Beet stand decreased with increasing concentration of herbicide. Some control of weeds at all rates. E. H. No. 2 applied at 2, 4 and 8 lbs./acre. Some reduction of beet emergence and some control of weeds at all rates. LFN 472 applied at 1 and 2 lbs./acre. Beet stand severely reduced with some control of broadleaf and grass weeds. IPC applied at 5, 10, and 20 lbs./acre. Sulfosan applied at 4, 8 and 12 lbs./acre. KOCN applied at 10, 20 and 30 lbs./acre. Chlorosol A applied at 20, 40 and 80 lbs./acre. No injury to sugar beets or weed control for these 4 herbicides. Diesel oil applied at 50 and 100 gal./acre. Beet stand reduced slightly at the higher rate. No weed control. Polybor applied at 320 and 640 lbs./acre. Sugar beet stand reduction noticeable at lowest rate and marked at highest. Good weed control. PCP in oil applied at 4, 8 and 12 lbs. per acre. NaPCP applied at 16, 24 and 32 lbs./acre. A progressive decrease in beet seedling emergence and vigor occurred with increasing concentration of PCP. No grass control. Some control of broadleaf weeds at higher rates of application. XP-39-A applied at 1, 3 and 5 qts./acre. Beet stand decreased at all rates. No broadleaf weed control. Some grass control at higher rate. (Contri. Div. Cereal Crops and Dis., BPISAE, U. S. Dept. of Agric., and N. D. Agr. Exp. Sta.)

Eradicating quack or twitch grass with sodium trichloro-acetate (TCA) and Chlorosol-A. Wood, H. E., J. J. Bourns, and H. J. Mather. Quack grass (Agropyron repens) on clay soil in Winnipeg was treated on three dates with TCA and on two dates with Chlorosol-A. Both were applied with knapsack sprayer using 110 imperial gal. per acre of water. The periods for TCA were, 1) early spring - May 21, 2) midsummer - June 27 with plants in flower and 3) late summer August 8 with seed ripe. TCA was applied on May 21 at 30, 60, 90 and 120 lb./A and on June 29 and Aug. 8 at 60, 90, 120 and 150 lb/A. On June 27 an extra series of plots was treated where grass was mown about 2 in. from ground. Several plots at other locations were also treated. Final appraisal cannot be made until 1950 but these results were rated: 1) less than 90 lb. gave only partial eradication, 90 lbs

looks promising and 120 and 150 lbs. decidedly promising; 2) results have been substantially the same for all three dates; 3) results were immediate and more definite on mown plots and 4) perennial sow thistle, Canada thistle an snowberry (Symphoricarpos albus) were killed back but recovered and brome grass showed almost complete survival. Chlorosol-A was used 50, 100 and 150 lbs./A. on May 27 and on June 27 at 110, 220 and 440 lbs./A. Of the May 27 treatments 150 lbs. gave slight browning but there was no effect from others. Very little effect was noted from even the heaviest dosage of June 27. (Contribution of the Weeds Commission, Manitoba Department of Agr., Winnipeg, Canada.)

Shield tests on mesquite (Prosopis juliflora). Young, Dale W., and C. E. Fisher. The shield test is a rapid method of testing the absorption and translocation of herbicides in a plant. This test consists in spraying the exposed branch of a plant with a herbicide under controlled conditions of application and noting the translocation of the herbicide by the effect on the leaves of the shielded or untreated part of the plant. If a solution of herbicide is absorbed and translocated in the shield test the same result should be expected in spraying an entire tree. The results of the shield test can be read one month after treatment, whereas a delay of an entire year is necessary when the whole tree is treated. Various formulations of herbicides have been tested in the above manner throughout the year. Some results are apparent. 1. Absorption and translocation of herbicides are not limited to any one time of the year except that no absorption and translocation were noted when the plant was dormant. 2. Absorption and translocation of herbicides are favored by a period of high humidity and a relatively high temperature. 3. The amine salt of 2,4,5-T in a water-oil emulsion is absorbed and translocated more consistently than any other herbicide tested thus far. 4. Chlorosol A is not absorbed by mesquite and a spray application at one pound per gallon will not defoliate mesquite. 5. Sodium trichloro acetate will defoliate the sprayed area but will not kill the stem tissues. 6. Ammonium sulfamate will be absorbed and translocated only under conditions of high relative humidity. 7. There has been no absorption and translocation of the ester of 2,4-D in oil and only limited absorption and translocation of the ester of 2,4,5-T in oil. 8. The amine of 2,4-D was absorbed and translocated only when some special agent, as glucose or Goodrite V. L. 600, was added to the carrier. (Contributed by the U. S. Bureau of Plant Industry, Soils, and Agri. Eng. and the Texas Agri. Exp. Station, Spur, Texas.)

Effect of trichloroacetates on cactus (Opuntia humifusa) when applied by different methods and at different rates. Zahnley, J. W. and G. L. McCall. Rates of 1/2, 1, 2, and 4 ounces of the sodium salt of TCA were applied to individual plants or groups of plants having a spread sufficient to cover approximately 25 square feet. This amounts to approximately 55 pounds to 440 pounds of the salt per acre of solid infestation. Since cactus rarely covers more than from one-eighth to one-fourth of the total area of an infested field the rate per acre will be proportionately less than indicated here, since probably only the cactus plants should be covered. The chemical was applied June 23, 1949, on duplicate plots in solution and in dry form. The solution was made in 1 quart of water and

applied as follows: (1) sprayed over all, (2) sprayed on the central area of the plant 12 to 18 inches in diameter, (3) poured in the central area, (4) poured along two sides of the plant and (5) poured along four sides of the plant. The dry salt was applied to the central portion of the plant. One third of an inch of rainfall ten hours after the applications and 3.35 fell five days after. Results from spraying the entire plant were far superior to other methods of application. Observations in October 1949 show that the two-ounce applications are about as effective as four ounces and that two ounces per plant is probably near the optimum dosage. (Contri. of Kansas Agri. Exp. Station.)

Increasing the effectiveness of sodium TCA by combining with tillage. Barrons, K. C. and Watson, A. J. Applications of TCA to quack and blue grass combined with various types of tillage has resulted in a greater kill than from TCA alone. Comparisons with tillage alone show the effect of combination treatments to be far greater than additive. The following gave promising results: (1) plowing two weeks after TCA application, (2) shallow plowing followed immediately by spraying of the upturned sod and (3) disking after spray application. Spraying followed immediately by plowing has consistently proved inferior to the above three methods. The best kill from low rates of TCA was obtained when sod was thoroughly disked in late spring, allowed to regrow for 6 weeks, sprayed with Sodium TCA, and then immediately disked again. Further work is needed on types of tillage and timing. However, these results indicate that combination treatments may make it possible to use relatively low rates of TCA for effective reduction of grass populations in preparation for a subsequent crop. (Contribution of the Dow Chemical Company)

Factors effecting field results with sodium TCA. Barrons, K. C. and Watson, A. J. Summarizing two years work in Michigan on quack and blue grass involving more than 1,000 plots treated with sodium TCA at frequent intervals from April to November, soil moisture appears to be the most important external factor. Best results were obtained on moderately dry soil with scant to moderate rainfall in the month following treatment with sodium TCA. Inferior results were obtained when applications were made to moist soil and followed by heavy rain. Although some applications made in spring and fall resulted in a high degree of control, summer treatments proved more consistent. Field observations and limited controlled experiments indicate that best kills may be obtained with TCA on grass low in carbohydrate reserves. Treated grass exhibiting typical low-nitrogen, high-carbohydrate symptoms appears more likely to show a high degree of bud dormancy followed by recovery. The factor of lower carbohydrate reserves may account for the superior results obtained when tillage is combined with TCA treatment. (Contribution of the Dow Chemical Company.)

Eradication of quack or twitch grass (Agropyron repens) with sodium trichloroacetate (TCA 60%). Breakey, W. J. A series of plots infested with quack grass (Agropyron repens) located in a pasture field, on a light sandy loam soil, were treated with varying amounts of TCA. The sprayer used was a hand-operated air pressure boom sprayer. A standard knapsack sprayer tank was used as the

source of air pressure. A 4-quart container was used for the solution. A constant pressure was maintained at 35 pounds when spraying. Six rates of application were used, namely 25, 50, 75, 100, 125, and 150 pounds of acid per acre. The grass when sprayed in early June was 10 inches high. All rates of application proved effective in retarding growth but only partial control was gained with the lower rates of 25 and 50 pounds of acid per acre. 75 pounds looks promising. Rates of 100, 125 and 150 pounds proved highly effective and killed all quack grass growth. No new growth was observed in late summer or fall on the plots where the three high rates of application were used. Other growth such as brome grass while killed back, later recovered and showed almost complete survival. (Contribution of the Dominion Exp. Sta., Morden, Manitoba)

Pre-emergence weed control in sugar beets. Sexsmith, J. J. Duplicate plots of sugar beets were treated six days after seeding with sodium pentachlorophenate at 20 and 40 lb. per acre, xanthogen disulphide at 5 and 10 lb. per acre, calcium cyanamide - powdered at 100 and 200 lb. per acre, and triethanolamine 2,4-D and butyl ester 2,4-D each at 3/4 and 1½ lb. per acre. The calcium cyanamide was applied in the dry form, and all other treatments were in water at the approximate rate of 300 gal. per acre (xanthogen disulfide emulsified with diesel fuel - 3 gal. per acre). Weed control of 80% or over was obtained from treatments with sodium PCP 40 lb., and amine and ester 2,4-D at 1½ lb. Relatively severe reduction of unthinned beet stands resulted from sodium PCP 40 lb. and all 2,4-D treatments. Varying degrees of malformation of early leaves were caused by above mentioned treatments as well as by xanthogen disulfide at both rates used. Significantly higher yields resulted from sodium PCP 40 lb., xanthogen disulfide 5 lb., and all 2,4-D treatments. However, there was a significant negative correlation between number of beets per plot and beet yields, and it seems probable that stand reductions due to treatments were primarily responsible for the decrease in numbers of beets harvested and the increases in yield. No significant differences in sugar content were obtained. Treatments which gave over 80% weed control and reduced stands of unthinned beets would materially reduce thinning and weeding costs. (Contribution of Dominion Exp. Station, Lethbridge, Alberta.)

Pre-emergence weed control in canning peas. Sexsmith, J. J. Duplicate plots of Climax canning peas were treated six days after seeding with sodium pentachlorophenate at 20 and 40 lb. per acre, xanthogen disulphide at 5 and 10 lb. per acre, calcium cyanamide - powdered at 100 and 200 lb. per acre, and triethanolamine 2,4-D and butyl ester 2,4-D each at 3/4 and 1½ lb. per acre. The calcium cyanamide was applied in the dry form, and all other treatments were in water at the approximate rate of 235 gal. per acre (xanthogen disulfide emulsified with diesel fuel - 3 gal. per acre). Reasonably good control of red-root pigweed and lambs' quarters was obtained with sodium PCP at 40 lb., amine 2,4-D at 1½ lb., and ester 2,4-D at 3/4 and 1½ lb. as judged by observation one month after treatment. The stands of peas one month after treatment were seen to be slightly reduced by sodium PCP 40 lb. and all 2,4-D treatments, with some stunting of plants observed for both amine and ester 2,4-D at 1½ lb.

No significant yield differences of shelled peas were obtained. Significantly lower weights of green weeds were obtained from all treatments with the exception of calcium cyanamide at 100 lb., with least weight of weeds from the sodium PCP 40 lb. treatment, amine 2,4-D at 3/4 and 1½ lb. (Contribution of Dominion Experimental Station, Lethbridge, Alberta.)

Response of clipped and cultivated quack grass (Agropyron repens) to rates and formulations of TCA. Warden, Robert L. The ammonium and sodium trichloroacetates were applied in water at rates of 300 and 400 lbs. of 70 per cent material (184 and 264 lb. acid equivalent) per acre on duplicate plots. The grass which was in the blossom stage of growth at treatment time on July 27, 1948 was also given two cultural treatments. One was clipping to a height of about 2 in. and the other was shallow cultivation with a hoe which did not disturb the rhizomes greatly but did cut the crowns. Extremely dry weather preceeded treatment by three weeks and continued for two months after application. The test area was irrigated by sprinkler about four weeks following treatment. Results indicated no difference between rates or formulations but did show a marked difference between cultural treatments. The eight clipped plots had considerable fall growth while the cultivated had very little if any. Final readings taken in the spring of 1949 indicated that the stand had been reduced an average of 82 per cent on the cultivated treatment and 36 per cent on the clipped plots. (Contribution of the Agronomy and Soils Dept., Montana Agricultural Experimental Station.)

The effect of five chemicals applied pre-emergence on corn. Aldrich, R. J. and C. J. Willard. Iowa 939 was planted May 18, 1949 at Columbus on Brookston silt loam. The experimental design was a randomized block with three replications. Plots were 2 x 10 hills in size. The following treatments were made May 21 (pounds active ingredient per acre): XP-40 (Sherwin-Williams) 4, 8, 12, 16, and 24 pounds, Pentachlorophenol (40% Dow Concentrate) 4, 8, and 12 lb., DN-289 (Dow) 2, 4, and 8 pounds, finely divided 2,4-D acid (Dow) 2 and 4 pounds, and amine salt of 2,4-D, 1½ pounds. A heavy rain fell within thirty minutes after the chemicals were applied. The predominant weeds were crabgrass, foxtail, pigweed and lamb's quarter, but there were not enough weeds to affect the yield of corn. Both 2,4-D compounds gave complete control of all weeds. PCP at 8 and 12 pounds per acre and DN-289 at 4 and 8 pounds per acre also gave good weed control. There was no indication of any weed control from any XP-40 treatments. Plants in all plots treated with 2,4-D showed typical 2,4-D affects shortly after emergence. There were no significant differences between the yields from the different treatments. (Contribution of the Ohio Agr. Exp. Station.)

Effect of TCA on quack grass and crops. Dunham, R. S. and R. G. Robinson. A quackgrass sod on silt loam soil, undisturbed in 1948, was divided into square rod plots and sprayed September 27-29, 1948 with TCA, ammonium and sodium salts, at dosages of 12 1/2, 25, 50, 100, and 200 pounds (active ingredient) per acre. Rates were 40 and 160 gals. of water per acre for the 12 1/2, 25, 50, and 100 and 200 pound dosages, respectively. A rate comparison using 50 and 100 lbs. of TCA, ammonium salt, in 40 and 160 gals. of water per acre

was also included. All dosages and rates were replicated 3 times within each of the following groups: 1. mowed and raked before spraying in 1948; cropped to oats, flax, red clover, soybeans, and corn in 1949. 2. mowed and raked before spraying in 1948; uncropped in 1949. 3. unmowed in 1948; cropped to oats, flax, red clover, soybeans, and corn in 1949. 4. unmowed in 1948; uncropped in 1949. On May 28, 1949 ragweed and morning glory covered all treated plots so all plots were sprayed with 2,4-D and good control of these susceptible weeds was obtained 2,4-D injured the red clover and slightly injured the flax; corn and soybeans had not yet emerged. All dosages above 12-1/2 lbs. gave good control of quack until June 1. By midsummer, some regrowth of quack had occurred on all plots. The 50 lb. dosage, though not as good in control of quack as the heavier dosages, appeared to be a practical dosage for following with tillage or a retreatment. Sodium salt was slightly superior to the ammonium salt and mowed was very slightly superior to unmowed. Oats and Setaria species matured without sign of injury. Leaves of flax and corn were "fired" at 100 and 200 pound dosages. Soybeans were badly injured at all dosages. (Contribution from the Div. of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 682. Misc. Jour. Series, Minnesota Agricultural Experiment Station.)

VII - 2. USE OF HERBICIDES FOR CONTROL OF UNDESIRABLE SEEDLING GRASSES.

Investigation leader: W. C. Dutton

Summary

Nine abstracts were received which were classed under this project, seven of which have to do with crab grass in turf, one with wild oats and foxtail in rape and one with annual grasses in flax. The names of materials and pertinent comments on results follow. TCA sodium salt gave no control of wild oats in flax or rape but gave 96% control of Setaria at 5 lb/A. The safety of this amount on flax has not been established. Rape and related crops apparently have some tolerance for it. TCA used for crab grass control in turf caused severe injury to blue grass in one instance (rate not indicated) but another report shows 5 and 10 lb. TCA to have given 96 and 100% control of young crabgrass with some injury to bluegrass but with recovery in 10 days. PMAS (phenyl mercury acetate) for control of crabgrass in turf was reported from three sources with variable results ranging from "generally poor", "held in check", to "complete control but killed 30% of bluegrass." Two organic mercury compounds (not named) applied in 2 leaf stage gave 75% control from two applications. L-2687 and L-2988 petroleum fractions in aromatics in one test used in three applications at 80 gal/A in seedling stage stopped growth and suppressed seed formation and one application at 120 gal. per acre when seed stalks were forming prevented seed formation. In two other trials L-2687 was not very effective. S-1980 and S-1998 gave fair to good results on crabgrass without injury to bluegrass and with 1998 being better than 1980. Potassium cyanate killed crabgrass if enough was used but effective rates usually injured bluegrass which in some instances recovered in about 10 days. Kerosene applied to crabgrass seedlings gave 70-80% control with 80 gal. per acre and 90-95% with 120 gal. and with no injury or discoloration to bluegrass, Stoddard solvent at 80 gal/A in two applications for one week apart gave complete kill of a heavy stand of crabgrass.

Abstracts of Results of Cooperators

PMAS and potassium cyanate on crab grass in lawns. Bibbey, R. O. PMAS, at the rate of 3 oz. of "Tat C-Lect" per 3 gal. per sq. rod, and potassium cyanate at 1.6 oz. per gal. per sq. rod were applied to randomized triplicate plots on a crab grass infested lawn. The season was fairly dry and the lawn received no artificial watering. Treatments were made when the crab grass was 1/4 - 2" in height, and when it was heading. PMAS acted slowly and a single treatment failed to give effective control of the crab grass. Two or three treatments, however, yellowed the crab grass and held it in check the remainder of the season. Potassium cyanate severely burnt the crab grass and the lawn grass (Kentucky Blue grass). Generally about 100% control of the crab grass was obtained, and the lawn grass recovered in a week or ten days. However, late germinating crab grass or the odd seedling that had survived the initial treatments made strong growth about September 1. Since the lawn grass was thin and offered little competition, several of the potassium cyanate plots deteriorated late in the season. Its effectiveness was not increased by the addition of a wetting agent. (Contri. of the Botany Department, Ontario Agricultural College.)

Response of wild oats (Avena fatua) and green foxtail (Setaria viridis) to TCA, sodium salt. Coupland, R. T. Avena fatua and Setaria viridis were seeded between rows of Argentine rape 6 inches apart on silty clay loam in the dark-brown soil zone at Saskatoon on May 10, 1949. Each plot consisted of 7 rod rows of rape and 3 rows of each weedy grass. Emergence of crop and weeds was delayed until June 8 because of deficient soil moisture. Duplicated applications of 2, 4, 8 and 12 pounds per acre of active sodium trichloroacetate per acre were made in 10 gallons of water. Treatments were made on June 21, when the rape was 2 to 3 inches in height and the grasses were in the 3 to 4 leaf stage, on July 6, and were repeated on both these dates. No damage occurred to the weedy grasses which could be attributed to the effect of the chemical. Competition of the rape was a more significant factor than was the effect of the chemical. This competition eliminated Setaria, which is adapted to coarse-textured soils, but did not prevent Avena from producing seed. Under the conditions of this experiment concentrations of sodium trichloroacetate up to 12 pounds of active ingredient per acre even when applied twice during vegetative development, did not effect the growth of Avena fatua appreciably. Preliminary tests of susceptibility of weeds to chemicals should not be conducted while the weed is competing with a crop unless the weed is known to be adapted to the soil type and climate and to be able to compete with the crop. Otherwise, competition may be more significant in reducing the vigor of the weed than is the herbicide. (Contribution of the Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Canada.)

Response of crab grass and kentucky blue grass to TCA, sodium salt. Lee, Oliver C. Replicated plots were treated with TCA at rates of 5, 10, 15, 25, 30, 35 and 40 pounds of acid per acre. Plots were located on a golf course of blue grass heavily infected with crab grass. Treatments were applied on July 3 at which time emergence of crab grass seedlings had started. Some burning and discoloration of the blue grass was noted on all plots treated. On plots receiving 5 and 10 pounds per acre the blue grass was not permanently injured and appeared normal some 10 days after treatment. Heavier applications destroyed or at least partially destroyed blue grass. Plots receiving 30, 35, and 40 pounds of TCA are free of any green shoots on plants except for dandelion and buckhorn plantain. Applications of 5 pounds of TCA reduced the stand of crab grass. A 90% kill was estimated. Only a few plants of crab grass survived on plots receiving 10 pounds of TCA. Later applications made after crab grass became established and well rooted did not show promise as a selective killer of crab grass in Kentucky Blue grass sod. (Contri. by Dept. of Botany and Plant Pathology, Agri. Expt. Station, Purdue University.)

Application of TCA for the control of annual grasses in flax in 1949 at Halstad, Minnesota. MacDonald, W. P., Slough, A. T., Zinter, C. C. Seventy percent sodium TCA was applied June 23 at 5, 10, 15, 20 and 25 lbs. of acid equiv. per acre. Three replications at each rate with plots randomized. Chemical was dissolved in water and all plots sprayed at the rate of 32½ gal. of solution per acre. Area treated was seeded to flax and badly infested with setaria, wild oats and occasional Canada and sow thistle. Setaria and flax 3 to 4 inches high at time of treatment. Setaria was losing color within 24 hours after treatment. Growth of Canada thistle and mustard was checked. No injury to flax was observed at any rate. No injury to wild oats. Estimated kill of setaria on July 29: 5 lbs. 96%; 10 lbs. 98%; 16 lbs. 98%; 20 lbs. 98%; 25 lbs. 99%. (Contri. of Agr. Dept., F. H. Peavey & Co., Minneapolis)

Controlling crabgrass selectively in bluegrass lawns. Shafer, Neal E. Crabgrass (Digitaria sanguinalis) L. Scop. infesting a bluegrass lawn was treated in plots 4 feet x 10 feet on June 25. One treated area contained only crabgrass seedlings, another treated area contained larger crabgrass plants with runners 4 to 6 inches long. Spray materials used included L-2687, S-1980, S-1998, potassium cyanate, phenyl mercuric acetate, and ordinary kerosene. L-2687 caused discoloration and reduced vigor but did not reduce the stand of crabgrass at either 80 gallons per acre or 120 gallons per acre. Potassium cyanate (1% and 2% in 10 gallons per 1000 square feet) gave an estimated 90 per cent kill of crabgrass but also eliminated much of the bluegrass. Phenyl mercuric acetate gave generally poor results. Kerosene at 80 gallons per acre gave 70 to 80 per cent kills of the seedling crabgrass, 120 gallons per acre gave 90 to 95 per cent kills without any visible injury or discoloration of the bluegrass. S-1980 (1% and 2% in 16 gallons per 1000 square feet) gave 60 and 75 per cent kills respectively without injury to the bluegrass. S-1998 (1% and 2% in 16 gallons per 1000 square feet) gave 95 per cent kill of the crabgrass with no injury to bluegrass. Much poorer results were obtained from all treatments which were

applied to the larger crabgrass plants. A second crop of seedlings was sprayed August 5 with approximately the same results. At the end of the growing season plots treated with S-1998 and kerosense were practically free of crabgrass and had a dense stand of bluegrass. (Contribution of the Dept. of Agronomy, Nebraska Agri. Exp. Station, Lincoln, Nebraska.)

Chemicals for crabgrass control (Digitaria sp.). Slife, F. W. The following chemicals were applied to bluegrass turf for crabgrass control: Potassium cyanate, organic mercury compounds, TCA, also S-1998, S-1980, L2687, L2988, all petroleum fractions. Applications were made to crabgrass when it was in the two leaf stage of growth. Plots were originally treated on June 25 and retreated on July 11, 1949. Effectiveness of these chemicals was measured by percent control of crabgrass and percent discoloration of turf. When manufacturers recommended rates were used the most effective chemical was S1998 which eliminated 90 percent of crabgrass after two applications. Other petroleum products were not particularly effective in these tests, however, rates were not varied enough to establish inferiority or superiority of these chemicals. Two mercuric compounds gave 75 percent control of crabgrass after two applications. TCA caused severe injury to desirable turf species at the rates used in these trials. Potassium cyanate when used at rates sufficiently heavy to eliminate the crabgrass, burned the desirable turf. Bluegrass recovered from this burning effect in about one week. (Contribution of the Illinois Agr. Exp. Station, Urbana, Ill.)

The use of Stoddard solvent in renewing lawns. Grigsby, B. H. Two lawns which were completely overrun with crabgrass were sprayed with Stoddard solvent at 80 gallons per acre in early July. One week later the spraying was repeated in order to kill the base of large clumps of crabgrass. Complete destruction of all crabgrass was obtained and within two weeks from the first spraying bluegrass and chewings fescue had started to recover. A reseeding with fescue was made and a perfect stand was obtained. No residual effects from the petroleum were observed and no further emergence of crabgrass occurred. (Contribution from the Michigan Agri. Exp. Station.)

PMAS for the control of crabgrass. Grigsby, B. H. Crabgrass in a lawn was given two treatments with a PMAS compound at the rates of 2, and 4 ounces per gallon of water per 500 sq. ft. Applications were made at five day intervals and stopped when injury to lawn grasses appeared. The two ounce rate gave a 50% control of crabgrass with only light injury to other grass. The 4 ounce rate gave complete control of crabgrass and a 30% kill of lawn grass, chiefly bluegrass. The bluegrass gradually recovered but a number of broadleaved weeds became established in the areas where grass had been killed. (Contribution from the Michigan Agr. Exp. Station.)

Selective control of crabgrass with petroleum fractions. Grigsby, B. H. Certain light oil fractions have been found to be toxic to crabgrass at rates which are not injurious to desirable lawn grasses. Two of these, very low in aromatic content, designated by the code numbers L-2687 and L-2988 were given extensive trials at various rates and in combination with other herbicides on lawn plots.

Three applications of either fraction at 80 gal. per acre prevented crabgrass from making any appreciable growth and suppressed seed formation. These applications were made when crabgrass seedlings were visible among desirable grasses. One application of 120 gal. per acre at the time when seed stalks were beginning to form killed 80% of the crabgrass plants and prevented seed formation. The addition of dinitros, PCP, TCA, Chlorosol A, IPC and cyanate increased the toxicity to crabgrass but also caused injury to the lawn grasses. (Contribution from the Michigan Agr. Exp. Station.)

Project VIII. Investigations on Physiological and Chemical Factors Influencing Practices in Weed Control.

Leader: W. E. Loomis

Summary

The abstracts submitted touch on four phases of the physiologic responses of plants to herbicides; susceptible stages in the grains, protein percentages in grains, penetration and translocation of herbicides, and toxicity studies. Work with corn (Staniforth, Iowa), barley (Derscheid, S.D.), and wheat (Shaw and Willard, Ohio) shows a pattern of the susceptibility of specific meristems for relatively short periods. In corn the tassel may be injured by spraying when the plants are 4-5 weeks old, the ear shoot inhibited by spraying at tassel emergence, and normal grain development prevented by spraying 2-4 days before silk emergence. Barley and wheat showed periods of maximum injury at the 3-5 leaf stage and again just before heading. The pattern of response of the three crops suggests that flower and perhaps tiller meristems pass through short periods of sensitivity to 2,4-D which should be avoided in a spray program.

The Ohio Station (Shaw and Willard) and the B.P.I. (Klingman) report that the significant increases in protein percentage of winter wheat obtained with heavier rates of 2,4-D application were due to lower yields. The protein percentage is higher when starch accumulation is interfered with, and the effect of 2,4-D is similar to that of drought or other factors which reduce carbohydrate storage.

North Dakota (Helgeson and Konzak), Wyoming (Bohmont) and Ottawa (Helson and Minshall) report on the toxicity of plant extracts and of oils. Bohmont found the heavier oils 10X more toxic than the lighter fractions of shale oil. Light treatments with the naphtha fraction appeared to stimulate bean plants. The general experience with oil is that the lower boiling point fractions low in aromatic and unsaturated compounds are least toxic, while aromatic compounds of the gas-oil boiling point range are most toxic. Stoddard solvent is low in aromatics and medium in boiling point. The Ottawa workers found that mustard would partly recover from naphtha sprays if adequately supplied with water. Their experiments with photosynthesis and respiration are interesting, and suggest profound protoplasmic effects from these only moderately toxic oils.

Heggenes and Johnson report on the relation of soil factors to the effectiveness of pre-emergence sprays and to the rate of disappearance of 2,4-D in soil. A peaty soil with 17.5% organic matter showed the most rapid recovery from 2,4-D applications.

Experiments on translocation of 2,4-D (Young and Fisher) are of major importance in the control of woody and perennial plants. The results reported by the Texas group, when added to previous results by various workers, suggest several hypotheses that should be of value in future work. They found esters not translocated. This result is probably a special result of their conditions and plant, but it suggests that we may expect poorer translocation through the phloem when excessive doses of the more toxic compounds are used. A number of us have been thinking of non-lethal ($\frac{1}{4}$ lb.?) doses of 2,4-D for perennials repeated 3 or 4 times within a week to obtain deeper translocation.

The Texas results with formulations are interesting also. Glucose and Goodrite V.L. 600 can hardly be expected to have the same physiological effect, even though both increased translocation of amines. The increased toxicity of amines applied with

wetting agents (Staniforth and Loomis, 1948 Rept.) is probably due to better contact and better absorption. The effect of glucose and the suggested effect of high temperatures may indicate that absorption as well as translocation of 2,4-D is an energy dependent process.

Abstracts of Results of Cooperators

Effect of 2,4-D on Meristematic Tissues of Corn. D. W. Staniforth. Plants of three inbred lines were sprayed with 1/2 lb. sodium salt of 2,4-D with 1/2 per cent Dreft 32, 39 and 45 days after seeding. At the first date of spraying approximately 2/3 of the plants examined showed the beginning of tassel initiation. Inhibition of tassel development, as evidenced by barren tassels and reduced numbers of lateral branches on functioning tassels, was severe when the 2,4-D treatment was made at the time of visible tassel initiation. Later treatments resulted in much less inhibition. A spray treatment of 1/2 lb. 2,4-D, made on a single cross of corn at tassel emergence, caused almost complete suppression of the ear shoot in some plants. Similar spray treatments made one to four days before the silks emerged resulted in severe reduction of seed set in the lower half or more of the ear. Spraying two or more days after silking gave no reduction in seed set. The effects of 2,4-D in reducing the development of tassels, in suppressing the development of ear shoots and in inhibiting seed set on developing ears, seemed to show a degree of similarity with respect to the kind of cells affected. Considering the three types of injury together, it seems possible that the inhibitory effect occurs during meristematic differentiation rather than cellular growth. The susceptible period is apparently relatively short, and the growth substance has evidently little if any effect on the growth of the once differentiated tassel. (Contribution of Botany & Plant Path. Section of the Iowa Agricultural Experiment Station.)

Some Effects of 2,4-D on Two Barley Varieties When Applied at Nine Stages of Growth at Brookings, South Dakota, in 1949. Lyle A. Derscheid. Triplicate fourteen-foot, four-row plots of Plains and Wisconsin #38 barley were treated semiweekly, with one pound of 2,4-D acid equivalent in the alkyl ester form, beginning with the 3-leaf stage and ending when Plains was headed. Stage of development of the growing point of the central culm was determined for each treatment, and yield, test weight, weight of 100 seeds, number of seeds per spike, number of heads per foot of plot and viability data were obtained. All data were analyzed statistically. Differences due to treatment at any of the stages were not established for viability, the number of seeds per spike, or the weight of 100 seeds. The yield of plots treated on the 1st, 3rd, 4th, 5th and 6th dates were significantly lower than the yield of untreated plots. The number of heads per foot on Plains plots treated on the 6th date were significantly higher than on untreated plots while the test weight of Plains plots treated on the 1st and 4th dates was also significantly higher than that of untreated plots. On the 1st date of treatment the spike of Wisconsin #38 was being differentiated and the yield was low. Spike differentiation may also have been taking place in the tillers of plants on plots treated on the 3rd, 4th, 5th and 6th dates. Although this experiment does not give a clear cut picture of why yields are reduced, it indicates that a correlation between injury and the stage of development of the growing point should be studied further. (Contribution of the South Dakota Agricultural Experiment Station.)

Physiological Effects of 2,4-D on Wheat. W. C. Shaw and C. J. Willard. Thorne wheat was planted October 4, 1948 and sprayed at 3 stages in the fall and at 7 stages in 1949. When an amine salt or a butyl ester was used at the rate of 1/2 or 1 lb. acre the 5-leaf spray in the fall and the late-joint to fully headed sprays in the spring gave serious yield reductions while spraying at other periods had

little or no effect. Dissections were not made, but these stages seem to have represented particularly susceptible stages in the development of the meristematic tissues of the plant.

Studies of protein percentage showed that increased protein content was associated with reduced yields when the fields were free of weeds. (Ohio University, Columbus, Ohio.)

Effect of 2,4-D and 2,4,5-T on Protein Content and Protein Per Acre of Pawnee Winter Wheat Grown in 1948. Klingman, Dayton L. Protein analysis was made of the wheat grain from plots reported in Abstract III-57 of the North Central Weed Control Conference Research Report of 1948. The average protein content and protein per acre for the various treatments on all four dates were as follows: check, 13.4% (392.3 pounds per acre); ester of 2,4-D, 1/8 pound, 13.6% (372.9 pounds per acre), 1/4 pound, 13.5% (374.2 pounds per acre), 1/2 pound, 13.7% (369.9 pounds per acre), 3/4 pound, 13.6% (337.8 pounds per acre); amine salt of 2,4-D, 1/2 pound, 13.3% (368.7 pounds per acre), and 1 pound, 13.4% (364.2 pounds per acre); and ester of 2,4,5-T, 1 pound, 14.1% (340.9 pounds per acre). Data in parenthesis above are pounds of protein per acre. The standard error of the mean difference for protein content in per cent is 0.5%. Differences between rates and between dates in percentage protein content were beyond the 1% level of significance, with the increasing rates of 2,4-D treatment tending to give higher percentage protein. However, when percentage protein is multiplied by the yield produced, the result (in parenthesis above) gives the opposite trend, ie., with increasing rates of 2,4-D treatment the yield of protein per acre decreased. The reduction in yield in bushels per acre was greater than the relative increase in percentage protein content of the grain. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A.)

Phytotoxic Substances in Some Common Perennial Weeds. Helgeson, E. A. and Richard Konzak. Germination and early seedling development of wheat, oats, flax and alfalfa were inhibited in varying amounts when aqueous extracts of oven dry tops or roots were used to moisten the filter paper substratum on which seeds were placed for germination tests. Weeds showing toxicity at concentration of 1:20 (one part plant residue, 20 parts water), 1:30 and 1:40 included leafy spurge (Euphorbia esula), Canada thistle (Cirsium arvense), field bindweed (Convolvulus arvensis), perennial sow thistle (Sonchus arvensis), Frenchweed (Thlaspi arvense), and quackgrass (Agropyron repens). Studies on the character of toxic principals are under way. (Contributed by N. D. Agricultural Experiment Station.)

Stimulatory Effect of Several Shale Oil Fractions on Bean Plants. Dale W. Bohmont. Three raw shale oil fractions, that of naphtha, kerosene and gas-oil were applied to Great Northern bean plants under greenhouse conditions. The oil was applied when all plants had 2 fully developed simple leaves as an oil-water emulsion spray. The concentrations ranged from 1% to 10% and the material was applied until each plant was thoroughly wetted. The 3 fractions varied in their phytotoxicity to bean plants. The 10% concentration of the naphtha fraction caused plant injury equal to the 5% kerosene treatment and to the 1% gas-oil fraction. Concentrations in excess of these amounts were very toxic to the plant and caused initial leaf burning and a generally dwarfed, unthrifty condition. All treated plants which survived the initial injury produced an abundance of axillary and adventitious buds. The adventitious buds developed into normal flowers and fruit. There was no abnormal floral development in the untreated plants. While all fractions at concentrations of 5% or less greatly stimulated the production of floral buds, the naphtha fraction pro-

duced the greatest increase. By flower and pod counts it was found that the 5% naphtha treatment increased production by 73% when compared to the untreated plants. The toxic condition of the gas-oil treatments while not lethal were sufficient to dwarf the plants and, although there was a definite bud stimulation, they remained unthrifty and produced an abundance of dwarfed compound leaves. The kerosene fraction appeared to be intermediate both in phytotoxicity and stimulation effect between the naphtha and gas-oil fractions. (Contributed by Wyoming Agricultural Experiment Station.)

Further Effects of Herbicidal Oils on the Photosynthesis and Transpiration of Plants. Nelson, V. A. and Wm. Harold Linshall. We have previously reported (NCWCC Research Report 1948: VIII - 17, 18) that on application of a petroleum naphtha to the attached leaves of parsnip and of mustard (1) photosynthesis of both plants was disrupted immediately and completely, (2) this disruption of photosynthesis while permanent for mustard was only temporary for parsnip, and (3) on application of the oil, transpiration ceased permanently in mustard, but, in parsnip it recovered after a temporary reduction. Further investigations have been made on the effect of the oil on the respiration and the photosynthesis of attached mustard leaves (a) when both surfaces were exposed to air and (b) when one surface was exposed to air and the other surface floated on water. The respiration of the leaf floated on water continued at a normal rate while that of the non-floated leaf quickly fell to zero and remained at zero. Under both treatments the photosynthesis was quickly reduced to zero but, although the photosynthesis of the non-floated leaf remained at zero, the photosynthesis of the floated leaf recovered to 25% of the observed maximum and remained at that level for the 6 hours of the test. If water is supplied directly to the leaf cells, therefore, the cells are not killed by the oil. With tomato, it has been found that application of the oil to the third leaf from the base decreased the transpiration of the terminal leaflet of the fourth leaf by approximately 40%, and also, application of the oil to the lateral leaflets of the fourth leaf decreased both the transpiration and the photosynthesis of the terminal leaflet by approximately 90%. In all cases this reduction of transpiration and photosynthesis was temporary and there was no permanent injury to the terminal leaflet. It would appear as if the application of the oil under such conditions temporarily prevented water from reaching the terminal leaflet. Although as yet no work has been carried out on the possible direct chemical effect of oils on leaf cells, the experiments to date suggest that it is a difference in the effect of the oil on the supply of water to the leaf cells that is responsible for the selective action on such plants as mustard and parsnip. (Contribution of Div. of Bot. & Plant Path., Science Service, Dom. Dept. of Agric., Ottawa, Canada.)

Treatment of Soil With 2,4-D Before Planting Flax. Heggeness, H. G. and Herbert G. Johnson. Four different soils were brought in from the field in October, 1949. Their characteristics were as follows:

Soil type	pH	% Org. matter	% Colloid	No. microorg. per gram Fungi	Bact.	Soil class
Peat	6.2	17.5	8.8	10,400	360,000	Silt loam
Mineral	7.0	5.3	12.0	5,000	460,000	Silt loam
Mineral	7.5	4.2	14.0	17,300	475,000	Silt clay loam
Clay	8.4	1.2	17.0	6,500	275,000	Sandy clay

The effect of the pretreatment of these soils with an amine salt of 2,4-D was studied. Three variables of four items each were used, i.e. 4 soils, 4 concentrations of herbicide, and 4 times of application of herbicide. Crystal flax was used as a test plant. The plants in soil with relatively high organic matter, low pH, and low colloid content gave the best emergence and growth. In general, emergence and growth were less at higher 2,4-D concentrations. This effect was considerably less in the case of the high organic soil. The greater the time elapse between application of 2,4-D and planting, the less the injurious effect of the 2,4-D. Applications did not affect the type or numbers of soil microorganisms. The 2,4-D appeared to diffuse uniformly through the soil. (Contributed by Minnesota Agric. Exp. Sta., St. Paul, Minnesota.)

Shield Tests on Mesquite (Prosopis juliflora). Young, Dale W. and C. E. Fisher. The shield test is a rapid method of testing the absorption and translocation of herbicides in a plant. This test consists in spraying the exposed branch of a plant with a herbicide under controlled conditions of application and noting the translocation of the herbicide by the effect on the leaves of the shielded or untreated part of the plant. If a solution of herbicide is absorbed and translocated in the shield test the same result should be expected in spraying an entire tree. The results of the shield test can be read one month after treatment, whereas a delay of an entire year is necessary when the whole tree is treated. Various formulations of herbicides have been tested in the above manner throughout the year. Some results are apparent. 1. Absorption and translocation of herbicides are not limited to any one time of the year except that no absorption and translocation were noted when the plant was dormant. 2. Absorption and translocation of herbicides are favored by a period of high humidity and a relatively high temperature. 3. The amine salt of 2,4,5-T in a water-oil emulsion is absorbed and translocated more consistently than any other herbicide tested thus far. 4. Chlorosol A is not absorbed by mesquite and a spray application at one pound per gallon will not defoliate mesquite. 5. Sodium trichloro acetate will defoliate the sprayed area but will not kill the stem tissues. 6. Ammonium sulfamate will be absorbed and translocated only under conditions of high relative humidity. 7. There has been no absorption and translocation of the ester of 2,4-D in oil and only limited absorption and translocation of the ester of 2,4,5-T in oil. 8. The amine of 2,4-D was absorbed and translocated only when some special agent, as glucose or Goodrite V. L. 600, was added to the carrier. (Contributed by the U. S. B.P.I.S.A.E. and the Texas Agric. Exp. Sta., Spur, Texas.)

Tip Immersion Studies on Mesquite (Prosopis juliflora). Fisher, C. E. and Dale W. Young. The tip immersion test is a rapid method of testing the translocation of herbicides when a constant supply of herbicide is made available for absorption by the plant. The tip immersion method consists in immersing the tip of a branch into a jar of herbicide for a period of 1 to 24 hours and noting translocation of the herbicide by the effect on the plant tissue. Various formulations of herbicides have been tested on mesquite at two-week intervals throughout the greater part of the year. Some results are apparent. 1. There is a wide range in the amount and distance of translocation from the time the tree comes into leaf in the spring until frost. 2. There has been no translocation of the ester of 2,4-D in oil and only a limited amount of translocation of 2,4,5-T in oil. 3. Oil emulsions of the amines and sodium salt of 2,4-D translocate much farther and faster than water solutions of the materials. 4. The addition of a wetting agent to a water solution of the salts of 2,4-D increased translocation of the material as much as the addition of an emulsifiable oil. 5. The addition of 5 to 20 percent oil to an emulsion of an ester of 2,4-D or 2,4,5-T did not increase translocation of the material. 6. Sodium trichloro acetate will translocate in mesquite, but it defoliates and does not kill

the tissue. 7. Chlorosol A will translocate in mesquite and it does kill the tissue of mesquite. 8. Ammonium sulfamate will translocate in mesquite and kill the tissues of mesquite. 9. There is no translocation when the mesquite is dormant. (Contributed by the Texas Agric. Exp. Sta. and the U. S. B.P.I.S.A.E., Spur, Texas.)

Miscellaneous Projects

In the Plan of Coordinated projects for 1949 the Research Committee did not develop detailed outlines for use by agricultural engineers, nurserymen, municipal or other forestry groups, and other fields in which some weed plant control work is being done. A limited number of abstracts of this sort were received and have been placed together as a miscellaneous item. The small number of abstracts and the wide variety of material does not warrant a regional summary.

Abstracts of Results of Cooperators

Equipment — Wm. P. MacDonald

Studies on Low Volume Spray Nozzles. E. B. Hudspeth, Jr. Agricultural Engineering Department, Michigan State College. Studies of spray nozzle patterns show that there is a wide variation in the uniformity of distribution in the different types and makes of nozzles. The nozzle is the most important part of the spray equipment because it is the metering device which controls the application of the chemical to the crop. A slight inaccuracy at the nozzle can result in serious damage to crops or a waste of chemicals.

The fan nozzle is the best for weed control because of its larger droplet spray. Atomized spray produced by hollow and solid cone nozzles has a greater tendency to fog or drift. The two-piece fan nozzle with a uniform pattern, an individual strainer, and a capacity of ten to fifteen gallons per acre meets the requirements for a general weed spray nozzle. Uniform distribution of spray material may be obtained from fan nozzles with capacities as low as five gallons per acre but these lower capacity nozzles do not give as even a pattern of distribution as those with higher capacities.

The pattern of each nozzle on a spray boom must overlap to give complete coverage, but double coverage does not necessarily give uniform distribution if the nozzles produce heavy edged patterns. Uniform pattern nozzles should be obtained. Nozzles purchased from experienced manufacturers will have reliable rated capacities if the speed of travel and pressure are as recommended. Each spray rig should be calibrated to make certain all nozzles are delivering a uniform pattern of the correct quantity.

With proper care, low volume nozzles should maintain the same pattern and capacity after three years of normal operation. (Contribution of Michigan Agricultural Experiment Station. Abstracted by H. F. McColly)

Observed differences in drifting of high and low volume spraying of brush. Klingman, Dayton L. and Shafer, Neal E. In an experiment comparing various rates of application of 2,4,5-T and 2,4-D on Osage orange there was also included preliminary treatments in which lower volumes per acre were used. There was a rather strong breeze directly parallel with the Osage orange hedge row, and the amount of vegetation killed past the end of the plots could be observed in the check next to the high volume (160 gallons per acre) and at the end of the experiment next to the low volume (16 gallons per acre) treatment. The actual distance of spray drift is not known, but the relative killing effects on leaves beyond the end of the treated plots was noted. In untreated plots next to the 160 gallon per acre volume, severe injury was noted 10 feet beyond the treated plot. Where the 16 gallon per acre volume was used, severe injury was observed to extend 50 feet beyond the treated plot. This would indicate that toxic quantities of the herbicides had drifted five times as far when applied in 16 gallons of water per acre as when applied in 160 gallons of water. Two weeks after spraying the low volume treatments looked equally as effective as the 160 gallons per acre treatments. The relative actual kill will not be determined since these plots have since been bulldozed. (Contribution of the Division of Cereal Crops and Diseases, B.P.I.S.A.E., U.S.D.A., and the Department of Agronomy, Nebraska Agricultural Experiment Station, Lincoln, Nebraska).

Nozzle testing by using a field crop. Larson, R. E. and Miller, J. H. Tests were made to determine the possibilities of using a field crop to test the distribution pattern of nozzles and also for checking or evaluating other methods of nozzle testing. Preliminary greenhouse tests of flax, peas, and soybeans showed the Wisconsin Manchu soybeans to be the best indicator crop in that the degree of bending in the stems seemed to be directly proportional to applications of 1, 2, 3, or 4 oz. of 2,4-D acid per acre. Laboratory tests of nozzles on a test stand using corrugated sheet showed nozzle distribution patterns in which the acid distribution would vary from 1 oz. to 4 oz. per acre. From these tests it was determined that to obtain a pattern in the field having a range of 1 to 4 oz. per acre the dose applied should be 2.5 oz. of acid in the amine formulation of 2,4-D. A test crop of soybeans was drilled in rows six inches apart with the plants spaced 2 to 3 inches in the row. The crop was sprayed across the rows so that the plants in each row would in effect give a profile of the distribution of the liquid. Variations in the tests included 2 heights of application and 3 volumes. While the data to date are not conclusive, certain trends are indicated. Close agreement of data on

particular nozzles between field application and laboratory testing, indicates that this method for testing nozzles has possibilities. (Contribution of Divisions of Farm Machinery and Cereal Crops and Diseases, BPISAE, U. S. Dept. of Agri., and Division of Agricultural Engineering, University of Minnesota).

Tests on 3 trailer type sprayers and one duster. Leggett, H. W. The following machines were field tested. 1. Hurst (Hurst Industries Inc.) 2. Eco (Service Station Equipment Co., Winnipeg, Canada) 3. Kromer (O. W. Kromer, Minneapolis) 4. Brandt Duster (Brandt Electric, Regina, Canada). Our comments on these machines are as follows: 1. Hurst. One of the most adaptable dual purpose machines on the market. The booms have no whipping action and are suitable for any type of land due to the booms being mounted on a framework of iron piping hinged to the trailer and carried on a small wheel. For ease of transportation it would be better if this fixed wheel were allowed to swivel so that the booms could be trailed behind the tank. One improvement made to the machine was by putting a filter between the pump and the boom. 2. Eco. A fairly good machine but has two bad faults which can easily be remedied. 1. Filter not large enough. 2. Filter is on suction side of the pump and should be changed to the force side. This caused the machine to plug completely after operating about ten minutes. Otherwise this machine operates quite well although the booms have a slight amount of whip and are not as adaptable to rolling land as the Hurst. 3. Kromer. Has a good tank and filter set-up but the booms have too much whip in them both horizontally and vertically and even in average field these are flapping continuously. 4. Brandt Duster. Quite a good machine, simple in operation and gives an even distribution of dust throughout the length of the boom. The feed scale should be adjusted as the holes do not feed correctly with the type of dust we used. On filing out the holes into a rectangular slot we were able to adjust it so that the correct amount of dust was put on the field on a per acre basis. This scale and feed arrangement appear to be the only changes necessary to make it a good duster. (Contribution Dominion Experimental Farms, Field Husbandry Division, Lacombe, Alberta, Canada).

Spraying to prevent fruit formation by various shade trees. Gordon King and Hammer, C. L. Seven species of shade trees were sprayed during their flowering period with various concentrations of three compounds in an attempt to reduce the amount of fruit produced by these trees. In the species selected fruit is undesirable because of the fleshy nature, or abundant seedling development which normally follows fruiting.

Naphthalene acetic caid (NAA), a commercial product which is the sodium salt of NAA, and a dinitrophenol compound were used. The latter compound is effective because it destroys the stigma and the upper part of the ovary. The NAA products act by causing abcission of flowers and flower clusters.

Best results were obtained with NAA sprays, at 40-60 ppm on Aesculus, Malus, Catalpa and Ulmus. Dinitrophenal at 1.5 lbs. in 50 gal. water was not effective on Malus and Morus and was not tried with other species. Neither material was satisfactory on Morus and Ginkgo.

It was found that sprays must be applied before all the flowers on a tree are open and that rain within 4 hours after spraying would cause poor results. (Contribution from Lansing City Forestry Department and Michigan State College.)

Symptoms resembling 2,4-D injury on Acer negundo. Sackston, W. E. Wrinkling, chlorosis and distortion of the veins of young leaflets was observed on secondary growth and seedlings of Acer negundo early in August, 1949. Earlier growth was not affected. Some of the affected shoots apparently recovered, while others died. Injury was observed only occasionally on tertiary shoots late in the season. The disorder was present throughout the agricultural area of Manitoba and eastern Saskatchewan, and was reported from wooded areas of north-eastern Saskatchewan 25 to 50 miles from agricultural settlements. It was reported also affecting several seedlings and new growth from an old stump at Brookings, South Dakota. The symptoms were typical of 2,4-D injury. Affected shoots occurred in many locations distant from fields known to have been treated with 2,4-D. The distance in some cases was so great that the damage could not have been due to normal drift of the chemical. Occurrence of the symptoms was so widespread and general that they could be attributed to 2,4-D only if fumes of the chemical were assumed to be present over great areas in sufficient concentration to affect young leaves of Acer negundo. Tomatoes present in some of the localities apparently were not injured. The possibility that the symptoms were caused by a severe frost throughout the area late in May is lessened by their occurrence on young seedlings that had not emerged at the time of the frost. (Contribution from the Dominion Laboratory of Plant Pathology Winnipeg, Manitoba, Canada.)

Use of Mineral Spirits for the Control of Weeds in Evergreen Nurseries. Day, Maurice W. Stanisol was applied with a boom sprayer to seedling and transplant beds of white pine, red pine, jack pine, Scotch pine, white spruce, Norway spruce and European larch. Forty-five to fifty gallons per acre were applied to two year old seedlings and older transplants at pressures of 40 to 60 p.s.i. without injury to the stock. On first year seedlings 35 gallons per acre at 25 p.s.i. were used with equally good results. More effective weed control was secured by spraying on clear warm days. Spraying was most successful in June and July and much less effective in Sept. and Oct. Small fast growing weeds were easily killed; whereas larger more mature weeds were only injured. Total reduction in weeding cost was estimated at 65%. White clover (Trifolium repens) and low cudweed (Gnaphalium uliginosum) were found to be resistant to this treatment. The following species were considered to be susceptible: purslane (Portulaca oleracea), lambs quarters (Chenopodium album), quack grass (Agropyron repens), barnyard grass (Echinochloa crusgalli), field sorrel (Rumex acetopersicaria), common chickweed (Stellaria media), ladys thumb (Polygonum persicaria) and sand spurry (Spergularia sp.)
(Contribution of Michigan Agricultural Experiment Station, Forestry Station)

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